Effect of organic contract farming on labor demand. A study case in the Western Uganda

Céline Guimas

Ecole d’Economie de Paris - Université Paris I
UFR 02 Sciences Economiques
Master 2 Recherche Economie Théorique et Empirique

Effect of organic contract farming on labor demand - A study case in the Western Uganda.

Présenté et soutenu par
Céline Guimas - 2012

Directeur de la soutenance
Professeur Mireille Chiroleu-Assouline

Effect of organic contract farming on labor demand - A study case in the Western Uganda.

1. Introduction

Goal 1: Eradicate extreme poverty and hunger
Goal 7: Ensure environmental sustainability

These are two of the eight Millennium Development Goals that have been defined by the United Nations in 2000. Organic contract farming has high potential for both of these goals and this is why this study is devoted to a better understanding of its effect. While it is clear now that Sub-Saharan Africa is off-track to meet its targets for 2015 (UN, 2011), it seems relevant to focus on this part of the world. Indeed with 30 percent of African population suffering from chronic hunger and a large population growth, any other continent is as concerned by poverty as Africa. The organic contract farming used here as study case is located in the western part of Uganda, in the Bundibugyo district. This region shares many common features with other African countries. Therefore, a deep understanding of this case may be useful for eventual replication of similar arrangement scheme.

For a better understanding of this study, I will explain why organic agriculture offers interesting potential for reducing poverty and why contract farming arrangement can be a successful tool for fulfilling this potential. However, in order to fully evaluate the impacts of organic contract farming scheme, it is necessary to evaluate the spillovers on the local community, including people that do not directly participate in such scheme. One of these spillovers is the creation of employment opportunities and this is the focus of this study. An increase in labor demand may limit conversion to organic farming in country where labor supply is scarce. However, in a country like Uganda where rural poor are often underemployed and have no - or too little - land to meet their own needs, job creation is a positive and crucial contribution for poverty alleviation. Hence, if organic contract farming increases labor demand, this deserves to be emphasized. For now, existing literature has never studied this specific consequence and thus, future research should rigorously quantify this effect on labor demand. My own study, though limited by data availability on farm labor input, is a first step in this important investigation. I will use a simple farm-household model in order to illustrate how farmers determine their farm labor demand as well as their farm and off-farm labor supply. This model has really modest purposes and aims only to give the main intuition about how the participation in an organic contract farming scheme can modify these decisions. At last, the empirical analysis will provide support for the main hypothesis that is tested: organic contract farming scheme increases the farm labor demand. Yet, results suggest this does not come from more labor intensive organic farm practices but mainly comes from higher price and product quality that are associated with the participation in this organic contract farming arrangement.

This study is structured as follows: Section 2 introduces potentials and challenges of organic agriculture and contract farming. Section 3 focuses on Uganda and on potential employment contribution. Section 4 presents the cocoa and vanilla organic contract farming scheme with the exporter Esco (U) Ltd. Section 5 is dedicated to a simple farm-household model. At last section 6 and 7, focus on the empirical investigation and its results.

2. Organic agriculture and contract farming. . .

In 2010, the global organic market represents US$ 59.1 billion while this was only US$ 17.9 billion in 2000 and was virtually zero at the beginning of the 1990s (Willer and Kilcher, 2012). Such market expansion is undoubtedly significant and has been mainly driven by North-American and European consumers. However, their own organic production can not satisfy their demand in tropical products and in year-round temperate products. As a result, certified organic import in these two regions has followed this growing trend and has offered significant export opportunities for many producers in developing countries. Nowadays, 160 countries all around the world are engaged in certified organic production (Willer and Kilcher, 2012). Besides, the interest of organic agriculture goes far beyond the simple market potential and that is why it has attracted a growing attention from activists and economists.

Organic agriculture: Introduction to its potential benefits

Multiple reports such as the one by Scialabba and Hattam (FAO, 2002), by Damiani (IFAD, 2002) on Latin America or by Giovannuci (IFAD, 2005) on Asia have documented the appropriateness of organic agriculture for small farming in developing countries. Markets offer a price premium for this differentiate agricultural production and organic products are part of the high value agricultural trade. In a world where terms of trade rarely benefit primary producers, this is a significant economic benefit for them (Parrot et al., 2006). In fact this 'organic price premium', added with the fall in input cost (synthetic fertilizer, pesticides, etc), is the main economic advantage for conventional producers[1]. Indeed, given the high market cost of these inputs, this is not a negligible advantage for most of them. Yet, stopping the use of synthetic inputs may also lead to a decline in yield and this is a potential issue. After conversion, usually yields considerably decline in the first year and then stabilize after the third year. This may stabilize at a higher, similar or lower yields level (Giovannucci, 2005). However, in developed countries, they typically stabilize at a lower level[2] and this trade-off between yield and input cost (added with other benefits) has to be taken into account for these countries before conversion. On the contrary, for developing countries, such declines in yield are far to be the rule (Badgley et al. 2007) and for traditional agriculture[1]only an improvement in yield is possible. Therefore, for traditional agriculture, little objection on this point can be done against conversion to organic agriculture. In addition, organics agriculture is considered to improve soil fertility, limit erosion and better withstand natural calamities such as droughts that are a major cause of food shortage. Empirical evidences also document that organic practices improve pest and disease control. Furthermore, organic system often requires crop diversity and therefore, added with the other benefits, organic agriculture exhibits a strong potential for improving food security (Giovannucci, 2005). Another advantage for producers is that, contrary to conventional farming, it does not have negative impact on health, does not require intensive water use and all necessary inputs can be domestically or locally supplied. As a result, all these elements of sustainability make organic agriculture a valuable tool to reduce poverty, in particular where conventional farming would be impractical, too costly or too damaging.

Challenges and solutions

Nevertheless, it will be unrealistic to assume there is no difficulty for traditional producers in order to catch fully all these benefits. While most of these advantages are intrinsic into the production system of organic farming, the income benefit, on the contrary, is dependent on many external factors such as market access and certification. Giovannucci (IFAD, 2005) has stressed that the most important factors for successful organic adoption are likely to be the institutional support system, the access to technology and finance for certification as well as the marketing capability. However, in many developing countries, such as in Africa for instance, there is no public assistance in order to help the conversion. Low domestic saving and difficult access to credit generally imply that farmers need financial support. Therefore, from a financial point of view, organic certification seems out of reach for most of them. In addition, organic conversion requires technical advices, high quality management, skills for setting up an internal control system, etc. Product commercialization also requires market information and a wide range of knowledge including marketing skills. These are likely to be impossible to satisfy for smallholders (Giovannucci, 2005). Hence, even though organic farming practices offer significant benefit in terms of soil fertility, biodiversity, etc., the organic price premium coming from the certification does not appear to be a realistic expectation for most of producers in developing countries without external support.

In order to make conversion possible, two common sources of support are available: from NGO or from contractual arrangement with private company. NGO's support exhibits some valuable advantages such as HIV/AIDS prevention or other services that are simultaneously offered. However market aspect is a primary

[1] *'Conventional agriculture'* refers to agriculture using synthetic inputs such as chemical fertilizers and pesticides. *'Traditional agriculture'* represents agriculture that does not use - or only in negligible quantity - synthetic inputs. At last, *'Organic agriculture'* is defined by IFOAM (2009) as "*a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science (..).*" Therefore, both absence of synthetic inputs and use of specific practices are within the concept of organic farming. Yet, these practices are not compulsory for being certified as organic product.

[2] This is a well documented fact in the literature. For overview, see for instance Nieberg and Offerman (2003) in Europe, Dmitri and Greene (2006) for US.

concern for farmers and unfortunately, development professionals are not often trained to help them to develop a strong market orientation (Giovannucci, 1999). As a whole, their "market seeking supply" approach has been evaluated less efficient that the "supply seeking market" of private firms (Guijt and Woodhill, 2008).This view is becoming increasingly recognized and this is why inviting private sector to provide marketing services appear to be a particularly relevant approach (Giovannucci, 2005).

Contract farming: Pros and cons

A contractual arrangement with a private company is generally named as a "contract farming" arrangement[3]. Particularly since the early 1990s, contract farming has attracted a lot of attention from researchers since this is a widely adopted type of arrangement[4] and its role is expected have a growing importance in developing countries (Bellemare, 2010). Some researches specifically focus on developing countries and/or Africa[5] and this enable to identify what are the potential outcomes from such arrangement in these countries. Obviously, private firm can have a crucial role for linking farmers to markets while ensuring to make business profitable. In the case of organic product, this implies that firm will provide a solution to all the main challenges that prevent smallholders from being certified. Firm will finance the high cost of certification, provide technical assistance and training for organic farming, set an internal control system, ensure the commercialization of products, etc. Say differently, firm may help to correct existing market failures (Grosh, 1994) and potentially contribute to increase welfare. However, firm also directly benefits of this form of arrangement through economies of scale and reduction of private trader's transaction cost (Simmons, 2002, Warning and Key, 2002, Poulton et al. 2004). As a whole, organic contract farming has strong potential to be a win-win strategy.

While individual rationality means that farmers engage in contract farming only if this increases their welfare, and firm only if this is profitable, empirical conclusions are not always so simple. Contract is written by private firm but the firm's goal is to maximize its profit. Such goal may be contrary to the interest of farmers and since farmers are possibly not well organized, it may be difficult for them to ensure fairness and enforcement of contract (Giovannucci, 2005). If the contract and relationship are not well balanced, that is to say this does not enable a mutual gain with a fair share of economic return, contract farming may simply be a tool for labor exploitation by capitalists[6]. Besides, as farmers are engaged in a specific-relationship with this scheme, their bargaining power may decline over-time and this may prevent them to rise their income in the long run (Little and Watts, 1994, Havnevik et al., 2007). This is obviously a key point because if firm captures all the return, the income benefit associated with organic certification will disappear for producers.

Another common critic is that contract farming increases rural inequality (Key and Runsten, 1999). Indeed, firm sometimes targets more established farmers, those that have superior factor endowments or greater experience of growing the crop (Gibbon et al., 2008). Yet, this argument is probably not strong enough to make contract farming a bad kind of arrangement. Even though contract farming may improve the welfare of better-off farmers while excluding the poorest of direct benefits, these better-off farmers consume local products, may create employment and as a whole stimulate local economy. Therefore, despite inequalities may increase, this does not impact negatively the poorest and on the contrary, they benefit from positive spillovers.

As a whole, contract farming is not always a panacea for poverty alleviation and contract has to be well-balanced in order to prevent exploitation of farmers. Yet, in my study case, this potential risk does not realized and the organic contract farming scheme with Esco (U) Ltd. has been a win-win strategy. As shown by the analysis of Gibbon and Jones (2011), the welfare impact of the scheme has been positive for members. Their revenue is significantly higher and since entry in the scheme has been possible for anyone living in selected areas, there is no direct selection of better-off farmers from the firm. Nevertheless, not everybody has joined: either because they were not living in selected parishes or because the cost was expected to be

[3] A classical definition of contract farming used in the literature is the one of Roy (1972) that defines it as a "*contractual arrangements between farmers and other firms, whether oral or written, specifying one or more conditions of production and/or marketing of an agricultural product*". Obviously this is a very broad definition but the functioning of the Esco scheme will be described later and will provide an illustration of this definition.

[4] See for instance the seminal articles of Roy (1963), Glover and Kustere (1990), Glover and Ghee (1992), Grosh (1994).

[5] See Kirsten and Sartorius, 2002, Simmons (2002), Röttger (2004), Gibbon and Ponte (2005), Bijman (2008), Minot (2009), Bellemare (2010). Besides, Oya (2012) offers a review of theoretical pros- and cons- of contract farming in Sub-Saharan Africa.

[6] See Glover and Kusterer (1990), Clapp (1994), Watts (1994), Porter and Phillips-Howard (1997).

higher than the benefit. For instance, this may be the case for owners of the smallest farms that can think that high requirements - mainly linked to organic certification or quality - were too demanding for only a very small production sold at Esco. As a result, in order to evaluate all impacts of the scheme, it is necessary to also evaluate the spillovers on the local community, including people that were not member of the Esco scheme. One of this spillover is the creation of employment opportunities and this is the focus of this study.

3. ...with a specific focus on Uganda and on potential employment contribution

The previous section has enabled the reader to understand the general potential of organic farming and contract farming arrangement. Yet, my contribution focuses on a very specific channel through which such scheme can alleviate poverty: the labor demand. In order to understand better the interest of this study, I will review the rather scarce literature on organic farming and position my own research within them. Then, I will introduce some important features of Uganda and its western part in order to contextualize this study case. Obviously different regions of the world offer similar features and that is why replication of similar organic contract farming scheme can be conceivable if evaluation is positive. I will then explain why rural labor opportunities are crucial for all poverty alleviation strategy. If organic contract farming contributes to improve welfare through this channel, this is an important positive spillover that deserves to be emphasized.

Literature review

Since organic farming is a relatively recent topic, the total literature is limited and only a small number of studies have been done on certified organic farming in developing country. These studies mainly focus on Latin America and Asia. Lyngbaek et al. (2001) focus on case in Costa Rica, Bray et al. (2002) in Mexico, Damiani (IFAD, 2002) in Latin America, Giovannucci (IFAD, 2005) in Asia, Tovar et al. (2005) in Mexico, Bacon (2005) and Valkila (2009) in Nicaragua, Eyrhorn et al. (2007) in India, Oelofse et al. (2010) in China and Brazil. Yet, recently some researchers have begun to investigate this phenomenon in Africa. This is the case of Gibbon et al. (2008), Bolwig et al. (2009) and Gibbon and Jones (2011) that focus on organic contract farming in Uganda, Bakewell-Stone et al (2008) in Tanzania, Guijt and Woodhill (2008) in East Africa and Thamaga-Chitja et al. (2008) in South Africa. Except for the latter two, the studies in Africa are based on organic contract farming schemes that have been supported by EPOPA[7]. Besides, most of studies do not report comprehensive farm budget data and only three studies, Bacon (2005), Bolwig et al. (2009) and Gibbon and Jones (2011), use econometric analysis. As a result, this is still an under-researched topic.

The three studies in Uganda report significant positive income benefit for scheme members. This comes from organic price premium and up-grading of product quality. Besides Bolwig et al (2009) report that organic practices increase yield while Gibbon et al. (2008) notice that food-security has improved but gender inequality has increased. Indeed, women decrease their off-farm labor to increase their work load into the farm. While farm income is typically controlled by men, women control their own off-farm income. Thus, women lose significant control over household expenditure when participating in the contract farming scheme. Nevertheless, all women agree that gain associated with this participation largely worth this drawback. To conclude, my research is in line with these three previous studies that aims to evaluate the effect of organic contract farming in Uganda. However, I investigate a new contribution of organic contract farming to poverty alleviation: the effect on labor demand.

Organic sector in Africa and Uganda

In Africa, there is slightly more than one million hectares of certified organic agricultural land. This represents around 3 percent of the world organic agricultural land and 34 percent of all the organic producers (i.e. 540 000 producers) in 2010 (Willer and Kilcher, 2012). Therefore organic certification is still marginal in Africa

[7]Export Promotion of Organic Products from Africa (EPOPA) is a programme created by the Swedish International Development Cooperation Agency (Sida) in 1994. Exporters usually work with EPOPA in order to review all the important aspects such as market demand, product quality price, farmer's interest, project organization and feasibility (Epopa, 1998). Besides, I use the same data set that Gibbon and Jones (2011) on the Esco scheme that has been kindly provided by Peter Gibbon. I sincerely thank Peter Gibbon and Sam Jones for their precious help.

and this can easily be explained by all the challenges stressed in the second section. Yet, what is striking is the spectacular rise of organic certification this recent year. Indeed, ten years ago, certified organic agricultural land was less than 60 000 ha, thus this corresponds almost to a 17 fold. Within this continent, Uganda has the most certified organic land with 0.23 million ha (i.e. 1.64 percent of all agricultural land in Uganda) and the most producers (188 625) (Willer and Kilcher, 2012). Since in 1999, only 7 000 farms were certified and were using only 0.06 percent of agricultural land, these figures illustrate the clear growing trend.

Despite local market initiatives are spreading rapidly in Uganda (Rundgren and Lustig, 2007), domestic market is still a very minor market and the great majority of certified organic product is destined for export market. Uganda is one of the leading African organic exporters and its export value for organic product was US$ 42 million in 2010-2011[8] (Willer and Kilcher, 2012). Smallholder contract farming is the main source of export from Uganda and Africa as a whole (Gibbon and Jones, 2011). Besides, certified organic export production in Uganda begun in 1994 with two export projects that have been the only ones until 1997, when the company Kofti get approval for a cocoa project in Bundibugyo (Gibbon, 2006). Because of security reason, the project only begun in 2002 under the ownership of Esco (U) Ltd. This is this scheme that I will study here and which have also been study by Gibbon and Jones (2011). In 2005, 17 certified organic export projects - plus 11 that were technically under "in-conversion" – were located in Uganda. Among them, one targets cocoa crop and five target vanilla, these are the two crops of our Esco scheme.

Cocoa is a relatively minor export crop in Uganda and is entirely produced by smallholders, mostly in the Bundibugyo district. In 2005, four companies were buying cocoa, and the only one being certified by sustainability standard is Esco (U) Ltd. Despite its high volatility, global cocoa price has followed an upward trend since 2000. This trend is mainly due to repeated global supply deficit and long-term problem in Cote d'Ivoire‘s production that is historically the leader of this market. Besides, these recent years have revealed a growing demand for high-quality product and sustainable production and this remains an area of expansion for cocoa (Gibbon and Jones, 2011). Consumers of organic cocoa require high quality and therefore organic cocoa has to satisfy some strict quality requirements. These high quality requirements are also essential for the exporters. Indeed, the demand for organic cocoa is rather irregular and organic exporters must be able to sell their product in the conventional market of "high quality cocoa" if needed. The price premium attached to quality depends basically on the color, flavor, size, absence of molds and appearance of beans. After harvesting, pods have to be open within three to five days in order to extract beans. Then, full fermentation of beans can take six or seven days and enables development of aroma and flavor. After fermentation process, the beans are washed and dried in the sun (ICCO, 2007)[9].

Vanilla production in Uganda became really established in the late 1990s. Yet, prices of vanilla are very volatile, especially during the last decade. They have known a heavy rise from 2000s to 2003, then a sharp decline due to the re-entry of Madagascar into the market[10].The organic certification of vanilla crop gives access to a luxury niche and was partly a response to this decline in global prices (Gibbon, 2006).

Ugandan context

In order to better contextualize the study, I will briefly describe some important socioeconomic features of Uganda. Most of these features give indication about why organic farming is adapted for a country like Uganda.

Uganda is a small landlocked country of East Africa. Its population is estimated reach 35,873,253 inhabitants in July 2012 (CIA, 2012). The Bundibugyo district – the district in which is settled the Esco scheme – is into the western region of the country. This district borders the Democratic Republic of the Congo. Its soil is volcanic and very fertile and the annual precipitation is about 2,150 mm while average temperature ranges from 28 to 35 °C. According to the Uganda Population and Housing Census (Ubos, 2002), the agricultural sector accounts for 73 percent of total employment for persons aged 10 years and above[11]. Agricultural sys-

[8]A few years ago, in 2005 (during the first survey's round of my data), organic export was estimated at $7 million (Willer and Kilcher, 2012).

[9]As stressed by Gibbon and Jones (2011), market taste and scientific research (Hii et al.,2009) indicate that high quality beans required timely natural fermentation and drying by sun rather than this being delayed and then dried mechanically.

[10]At this time, Madagascar and Indonesia supplied almost all the global market. In 2000, Madagascar was hurt by cyclones that destroyed almost all the vanilla crop. This had been followed by political crises and, therefore, this is only at the end of 2003, that Madagascar went back into the global market, causing a drastic fall in the vanilla price.

[11]Uganda is quite representative to Sub-Saharan African population as a whole. This is estimated that 80 per cent of African

tem is still highly traditional and consumption level of synthetic fertilizer is extremely low - with 1.0 kg/ha in 2005 for instance (World Bank) - and has been stagnant, as in most African countries[12]. The reason of non use is mainly: "too expensive" but also for the western region: "Not available" (Ubos, 2010). Besides, among agricultural household, only 0.9 percent practice irrigation (Ubos, 2010). These are therefore arguments toward organic agriculture. Indeed conventional agriculture often requires irrigation so as to make chemicals input fully efficient. In Uganda (and in most African countries), this is not a realistic solution for most of agricultural household. On the contrary, organic farming does not require costly market-supplied inputs and appear to be more easily feasible.

The prevalence of undernourishment in total Ugandan population was estimated to 22 per cent in the period 2006-2008 (FAOSTAT). This level is defined by FAO as "moderately high", and is indeed relatively moderate compare to other Eastern (or even Central) African countries. Among the Ugandan agricultural households, 56.7 percent (Ubos, 2010) have reported that their members were not able to afford eating normally during the year. Among them, 91.5 percent experienced drought and 66 percent pest and disease that have caused food shortage. Organic system enables to better withstand drought, that is to say that falling in yield is significantly lower while drought happens (Giovannucci, 2005). In addition, organic practices have potential for improving pest and diseases controls (Giovannucci, 2005). There exists a wide range of integrated pest management that includes provision of habitats for beneficial organisms, crop rotation and nutrient management for instance that may help agricultural household to prevent – or soften – these food shortages.

If we have a look on the education level of agricultural households, we see that only 55.1 percent of male and 44.9 percent of female members are able to read and write. We find also that for the Bundibugyo district (in line with national figure), 14 percent of households are headed by a member (male or female) that cannot read and write[13]. As a result, this limits the possibility for becoming certified for these households. For instance, in the Esco scheme, the Internal Control System - necessary for certification - requires to keep the record of all the cocoa purchased by Esco. This kind of requirement, very common for organic certification, is likely to act as a barrier to entry for this 14 percent of household (that are also likely to be the poorest). Another comment is linked to the general low level of education in Uganda. One of the important lessons we have drawn from the Asian experience is that investment in schooling is crucial so as to make possible more remunerating off-farm activities – that are in fact the major driver for massive improvement in wealth. This implies that, the first step of the development process is to increase income of rural population in order to enable investment in education (Estudillo and Otsuka, 2010). This first step is critic and cannot be skipped. While no-one argues that organic farming offers the prospect for high economic growth and is the ultimate solution to poverty, organic farming may valuably contribute to this initial step by rising the income of certified farmers (and on the community through positive spillovers). Before ending this general contextualization, information about demographic and land holding seem required.

The annual population growth rate in the Bundibugyo district was estimated at 4 percent[14] (Ubos, 2002) and the average household size is 6 (Ubos, 2010). While 93 percent of Agricultural households own their land, the national average holding size is 1.1 ha at the national level and only 0.8 ha for the western region. This basically means that population is quickly growing while average holding size is already small to provide resource for a family. This trend may intuitively justify the focus on employment opportunities.

Rural labor market and benefit from job opportunities

An important aspect of certified organic farming has for now been omitted. This is its impact on labor demand. In fact, this impact has never been rigorously studied but this is generally accepted that organic farming practices are more labor intensive. Compared to conventional agriculture (i.e using synthetic inputs), IFAD's reports (Damiani, 2002 and Giovannucci, 2005) clearly state that organic practices increase labor requirement. This is supported by Oelofse et al. (2010) that have studied medium-high input system prior to

depend on farming or related activities and that 30 percent suffer from chronic hunger and malnutrition (FAO conference, 2011).

[12] Synthetic fertilizer consumption level was as low as 12.3 kg/hectare for 2002-003 in Sub-Saharan while it was 106.6 kg for South Asia and 89.5hg for Latin America. Besides, the consumption in 1980 was 14.2 kg/hectare. (Kelly et al., 2005).

[13] In fact Ubos (2010) informs that agricultural households in Bundibugyo District are such as: 90 % are headed by a male, 10 % by a female and that among the male-headed 94.7 % can read and write while only 5.3 percent among the female-headed household. Therefore: 90*(0.947) + 10*(0.053) = 85.76% of agricultural households can read and write.

[14] At the national level this is slightly lower with an annual growth rate of 3.582% (estimated by CIA, 2012).

conversion. However these studies, as all available ones, never use econometric approach to evaluate this rise in labor input. We have only simple statistics and comparisons with conventional producers. Consequently, there are two problems. First, these study compare organic to conventional agriculture, thus they do not compare to traditional agriculture. Therefore for African country like Uganda, we can not use such results since agricultural systems are absolutely not comparable. Second, simple statistics do not provide rigorous information. For instance, if organic producers own more land than conventional producers, there is nothing surprising they use more labor. Therefore we have to control for individual characteristics and possible selection bias.

For Eastern Africa, Guijt and Woodhill (2008) report *"(...) the heavy work load resulting from the organic agriculture practices taught. In particular, gathering the organic material needed for mulching and composting as well as establishing contour bunds was always remarked [by smallholders]. How much extra work this means is unknown, no data was available nor could farmer informants specify numbers of hours required extra for specific activities"*. In Uganda, existing studies also suggest an increase in labor requirement. Gibbon et al. (2008) indicate that organic farmers in the pineapple scheme in central Uganda hire more labor than control farmers. Besides Bolwig et al (2009) report that the coffee scheme in Eastern Uganda has changed the repartition of the family labor. Women decrease their off-farm labor to increase their labor effort in coffee farming and processing. First issue, this increase in labor requirement is absolutely never quantified. Second issue, for Uganda we do not know exactly what are the reasons behind this increase in labor input. This may be partly motivated by higher output price that gives incentive to increase production. In this case, this is the organic price premium that is the main explanation. Besides, organic practices and/or up-grading the quality may also be labor intensive and explain higher labor input.

To conclude, the effect on labor demand of certified organic agriculture has never been studied in the existing literature. This is limiting and future research should rigorously quantify it in order to evaluate all the consequences of organic agriculture. My own study is only a first step in this investigation.

If we assume that organic agriculture raises labor requirement because of labor-intensive practices this may be an important issue where labor supply is scarce. Nevertheless Uganda, as most African country, is not in this case. The official estimate about rural unemployment in Uganda is low with only 1.1 percent of unemployed in 2005/2006 (Ubos, 2007). However, rural underemployment is estimated to 12.6 percent and this is, in fact, this figure that is interesting for studying the rural labor situation. Despite huge difficulty for estimating the share of underemployed workers, this figure indicates there is a significant under-utilization of the rural labor force in Uganda. Virtually everybody supplies some labor in order to support themselves and their family but a significant part would like to work more. Therefore we are in a sub-optimal situation and providing productive labor opportunities is a desirable outcome. Besides, providing employment opportunities for underemployed people has very strong potential for poverty alleviation. Indeed, these people are likely to be those that suffer of the deepest poverty. Among them, landless and quasi-landless are likely to be predominant since they disproportionately experience the most abject poverty[15]. Rural poor have often no – or too little - land to meet their own needs and therefore heavily dependent on labor opportunities for survival. In such context, job creation is a positive and valuable contribution for poverty alleviation.

The 1999/2000 National Household Survey (Ubos) found that 21 percent of rural households have zero landholding and this is deteriorating through time (Ainembabazi, 2007). Indeed, there is an increasing problem of land scarcity in Uganda (IFAD, 2012). Nabbumba-Nayenga (2003) reports that demographic characteristic is identified as the mot important cause in this trend. Yet, the second cause is the sale of land by poor people themselves. Indeed there is a bi-directional relationship between poverty and landlessness (Ainembabazi, 2007). Land can be sold under the pressure of immediate needs. This de-accumulation of capital worsens the situation and pushes this rural population in a deeper poverty. While organic contract farming does not have direct influence on demographic variable, potential employment creation may provide additional income and thus, indirectly contribute to prevent such land selling. Therefore, by providing employment to the poorest, this help landless and other rural poor to meet their basic needs while it may also stop this vicious poverty-trap that leads to land selling and to deepen poverty. Obviously organic contract farming is only a small contribution and this is far to be enough to stop landlessness and solve poverty. Yet,

[15] See World Bank (2008). This affirmation is true in most African countries. See for instance Cramer and Pontara (1998) for Mozambique or Barrett et al. (2001) for Cote d'Ivoire, Kenya and Rwanda.

in a country with 22 percent of undernourished people (FAOSTAT)[16], where land is becoming a very serious problem and where rural population is underemployed, all positive employment contribution is welcome. As a result, if organic contract farming increases labor demand, this deserves to be stressed. This positive effect does not concern neither the scheme members nor the exporter but this enables to affect positively some other households – likely to be the poorest. Besides, contract farming has been blamed to increase inequality through selection. Even in the Esco scheme –without farmer selection from exporter – the poorest are likely to be excluded since a minimum level of education or land is *de facto* required. As a result, this labor effect may weaken the rise of inequality associated with contract farming.

At last, creation of rural employment also contributes to rural stabilization. In many African countries, the rural-urban migration is a source of important problems and therefore organic contract farming can also bring a positive contribution on this point. Yet, as far as it is in my knowledge, this issue is not particularly relevant for Uganda and thus, I will not detail further.

In order to summarize previous sections, the interest of this topic is threefold. First, this enable to weaken the existing critic of contract farming that states that such arrangement increases inequality. Second, rural employment opportunity is crucial for all poverty alleviation strategy in country with similar features to Uganda. At last, and more importantly, this contributes to a better knowledge about organic contract farming through a new focus.

4. The Esco's scheme

Since the general environment of the Esco organic contract farming scheme has been contextualized, I will now present its functioning. This part is based on Gibbon and Jones (2011) and Gibbon, Lin and Jones (2009) but I will describe here only the main features[17].

The organic contract farming is located in the foothills of the Rwenzori Mountains in Bundibugyo district. The altitude is of 635-900 meters, the average rainfall of 2150 mm per year and the average temperature of 28-35 degrees Celsius. Cocoa is the main export crop of the district and it experiences few plant health problems[18].The district is remote and its mobile telephone and electricity coverage is poor. The organic cocoa contract farming scheme started initially in 1997 but due to insurgency and rebel insecurity, authorities ordered the population to move to camps for internally displaced persons. After insurgent's defeat, the scheme was resettled in 2001, but controlled by Esco (U) Ltd. The company decides to add vanilla to the scheme certification in order to improve economies of scope and reduce risk, both for itself and farmers. None of the other crops are certified.

Before the first export in October 2002, Esco had selected eligible parishes[19] based on an informal assessment that includes the number of cocoa farmers and their specialization in cocoa production. Once parish was eligible to join the scheme, there is no barrier to entry for farmers. In order to ensure the organic group certification, an internal control system (ICS) is used. This system is based on annual or semi-annual farm inspections that are done by 'field officers'. These officers have been trained in organic farming methods and monitor the compliance with organic standards and other requirements. They also supply technical advices and information about farm practices that should enhance yield. Field officers also train some 'contact farmers' who run demonstration plots in each of the villages of the scheme area. Buying posts are setting into the area and cocoa beans are bought with an organic price premium only if they have been fully fermented and properly dried. The contract states that Esco commits to buy all high grade crops that is offered by farmers. Esco also guarantees price premium for their production and a transparent measure of quality. From the farmers' point of view, they are free to engage in processing cocoa and selling with Esco or other sellers. Therefore, this is not a formal membership and one expects that farmers decide to supply high quality cocoa and sell to Esco if and only if they get benefit from that.

Yet there is some differences between 2005 and 2009 (that are respectively the first and the second round of the survey). In 2005, only two parishes were under this scheme and this represented 1,721 registered

[16] This represent a slight increase compare to 1990/1992 when the share of undernourished persons was 19 percent (FAOSTAT).

[17] For a more careful and detailed presentation, see these two papers.

[18] Black pods, witches broom, swollen shoot diseases, etc. are more common where production is in large mono-cropped plantation (Bowers et al., 2001). This is not the case in Bundibugyo district that has a more bio-diverse context.

[19] Ugandan administration distinguishes district, county, sub-county, parish and village level.

members. There were only four hired field officers and 30-40 contact farmers. The price offered for organic cocoa was 30 percent higher than conventional one of similar quality and 100 percent higher than unfermented conventional cocoa. However, certified farmers complained that buying posts were sometimes running out of cash and could not buy their production. In 2005, 269 tons of organic cocoa and 50 tons of uncured vanilla have been sold to Esco. Despite the elapsing of the support from Sida[20], the scheme has been extended to other parishes and in 2009, a total of 6,950 farmers were certified[21]. Field officers were now 30-35, training increased, and even a saving society has been initiated by Esco. Buying posts were always able to buy crops and technical instruments were employed to read moisture level. Therefore, the price was not relying on subjective assessment but based on a precise system of premium/discount depending of the moisture content. The organic price premium was 16-18 percent higher than conventional cocoa with similar quality. Besides, all prices have moved upwards since 2005. In 2008, the organic purchase of cocoa has risen to 2,593 tons and thus this represents almost a tenfold increase.

Hopefully, all previous sections have enabled a better understanding and contextualization of this study and I will now explain how farmers determine their farm labor demand.

5. How is determined the labor demand of farmer? – A simple farm-household model

This simple model aims to illustrate how farmers allocate their labor between farm and off-farm labor supply and how they determine the labor demand in farm. This model, mainly based on Benjamin (1992) and Blanc et al. (2008), will enable to understand how these decisions can be affected by the participation in the Esco scheme.

When markets are complete and efficient, agricultural households separate their consumption and production decisions. Say differently, they decide independently of their labor supply (and the repartition between farm and off-farm work) and their labor demand. Under neoclassical assumption of perfect labor market, individuals participate in off-farm work as long as their reservation wage (i.e their marginal value of farm labor) is less than the off-farm wage rate (Becker, 1965, Gronau, 1973). However, if labor markets are imperfect, consumption and production decisions (i.e labor supply and labor demand decisions) will be jointly determined (Sadoulet et al. 1998) and farmers may not participate in the off-farm labor market even though their reservation wage is less than the off-farm wage rate (Blundell and Meghir, 1987). In such situation, the actual participation in off-farm labor market mainly depends on incentive and their capacity to participate (Reardon, 1997). This is case for instance if there are substantial entry or mobility barriers with the off-farm sector (Barrett et al., 2001). In fact, assumptions for perfect labor market are far to fit with empirical evidences in developing countries. As a result, this is very common to assume non-separability between production and consumption decisions[22]. Therefore, I will not use the neoclassical model but I will assume the non-separability of decisions through a farm-household model.

The household utility function $U(.)$ is assumed to be twice differentiable, quasi-concave, and depends positively on consumption of good C and leisure l. Besides, utility level also depends on household characteristics, such as age and sex, represented by a vector of parameters a that is assumed to be exogenous. The price of the consumption good is normalized by 1.

The production function of the farm is assumed to be twice differentiable and convex. This is denoted $q = F(L, A)$ and depends positively on the labor input L and land A. Land is assumed to be fixed and exogenous. L is defined such as: $L = L_h + \alpha L_f$ where L_h corresponds to the hired labor and L_f to the family farm labor. The output price is denoted p. The wage rate of hired labor is w_a. We assume that hired labor and family labor are perfect substitute. Yet, if $\alpha \neq 1$, they have different efficiency and the two kinds of labor are not equivalent. As a result, the total labor input L is measured in "hired-labor equivalent efficiency". In the case where $\alpha > 1$, family labor is more efficient than hired one.

The total time available to the household (T) is allocated between leisure l, work on the farm (L_f) and

[20] Esco have received the support of Sida, though the Epopa programme, cf. note 7.

[21] Yet, we are studying data for the 2008/2009 season and not all the 6,950 farmers were already certified to start season as organic producer.

[22] For studies assuming non-separability because of missing market or constraint in the labor market, see for instance Lopez (1984), Benjamin (1992), Jacoby (1993), Skoufias (1994).

work off the farm (L_o) such as $T = L_f + L_o + l$. The off-farm labor wage rate is w_o and is exogenous. In the household utility function $U(C, l; a)$, both type of work, L_f and L_o, are perfect substitute, thus they have exactly the same disutility[23]. Besides, there is an exogenous income y, that can represent for instance received remittances.
The objective of the household is to maximize its utility $U(C, l; a)$ subject to time constraint (2), income constraint (3), labor input constraint (4), and non-negativity constraints on labor time (5) (6). Thus, the household's programme is defined by:

$$\underset{\{L_f, L_o, L, L_h, C, l\}}{Max} \; U(C, l; a) \qquad (1)$$

subject to:

$$\begin{aligned}
T &= L_f + L_o + l && (2)\\
C &= pF(L, A) - w_a L_h + w_o L_o + y && (3)\\
L_h &= L - \alpha L_f && (4)\\
L_o &\geqslant 0 && (5)\\
L_h &\geq 0 && (6)
\end{aligned}$$

Let denote $\mathscr{L}$, the Lagrangian associated with this programme, and $\lambda_1, \lambda_2, \lambda_3, \mu_1, \mu_2$ the Lagrange multipliers associated with the constraint $(2) - (6)$.

$$\mathscr{L} = U(C, l; a) + \lambda_1 [T - L_f - L_o - l] + \lambda_2 [p.F(L, A) - w_a L_h + w_o L_o + y - C]$$
$$+ \lambda_3 [L_h - L + \alpha L_f] + \mu_1 [L_o] + \mu_2 [L_h]$$

The first order conditions for a maximum are such as:

- Consumption: $\frac{\partial \mathscr{L}}{\partial C} = U_C{}' - \lambda_2 = 0 \Longleftrightarrow \lambda_2 = U'_c$ (7)
- Leisure: $\frac{\partial \mathscr{L}}{\partial l} = U'_l - \lambda_1 = 0 \Longleftrightarrow \lambda_1 = U'_l$ (8)

  Therefore from (7) and (8): $\frac{\lambda_1}{\lambda_2} = \frac{U'_l}{U'_C} = MRS_{l/C}$
  This ratio is the marginal rate of substitution (MRS) between leisure and consumption and represents the reservation wage of the household.

- Off-farm labor: $\frac{\partial \mathscr{L}}{\partial L_o} = -\lambda_1 + \lambda_2 w_o + \mu_1 = 0 \Longleftrightarrow \frac{\lambda_1}{\lambda_2} = w_o + \frac{\mu_1}{\lambda_2}$

  - If $\mu_1 = 0 \Rightarrow L_o > 0$, and $\frac{\lambda_1}{\lambda_2} = w_o + \frac{\mu_1}{\lambda_2} \Rightarrow w_o = \frac{\lambda_1}{\lambda_2}$ (10)
  $\Longleftrightarrow w_o = MRS_{l/C}$
  In this case, household supplies off-farm labor until the off-farm wage equals the reservation rate.

  - If $u_1 > 0 \Rightarrow L_o = 0$ and $w_o + \frac{\mu_1}{\mu_2} = \frac{\lambda_1}{\lambda_2} \Rightarrow w_o < \frac{\lambda_1}{\lambda_2}$ (11)
  In this case, household does not supply off-farm labor because the off-farm wage is lower than the reservation wage.

- Family farm labor: $\frac{\partial \mathscr{L}}{\partial L_f} = -\lambda_1 + \alpha \lambda_3 = 0 \Longleftrightarrow \alpha = \frac{\lambda_1}{\lambda_3}$ (12)
- Labor farm demand: $\frac{\partial \mathscr{L}}{\partial L} = \lambda_2 . p . F'_L - \lambda_3 = 0 \Longleftrightarrow p.F'_L = \frac{\lambda_3}{\lambda_2}$ (13)
- Hired labor: $\frac{\partial \mathscr{L}}{\partial L_h} = -\lambda_2 w_a + \lambda_3 + \mu_2 = 0 \Longleftrightarrow w_a = \frac{\lambda_3}{\lambda_2} + \frac{\mu_2}{\lambda_2}$

[23]This assumption, though common, is limiting. Indeed, Lopez (1984) and Fall and Magnac (2004) have shown that this was generally not supported. Yet, since the very modest purposes of this model, simplicity is paramount.

- If $\mu_2 = 0 \Rightarrow L_h > 0$ and $w_a = \frac{\lambda_3}{\lambda_2}$

According to (*10*) and (*12*), this can be rewritten such as :

$w_a = \frac{\lambda_3}{\lambda_1} \cdot \frac{\lambda_1}{\lambda_2} = \frac{1}{\alpha} \cdot MRS_{l/C} \Longleftrightarrow \alpha w_a = MRS_{l/C}$ (*14*)

- If $\mu_2 > 0 \Rightarrow L_h = 0$ and $w_a > \frac{\lambda_3}{\lambda_2}$

$\Longleftrightarrow \alpha w_a > MRS_{l/C}$ (*15*)

In order to facilitate the interpretation of these first order conditions, I will distinguish four different cases. α is assumed to be superior to one, thus the family farm labor is more efficient than hired farm labor.

- First case: $L_o = 0$ and $L_h = 0$, the household neither hires nor sells labor.

From (*11*), we know that $L_o = 0 \Rightarrow w_o < MRS_{l/c}$ and from (*15*), $L_h = 0 \Rightarrow w_a > \frac{1}{\alpha} MRS_{l/c}$.
Therefore, in this first case : $w_o < MRS_{l/C} < \alpha w_a$.
In this case, only the family supplies labor in the farm: $L = L_f$. Indeed, the agricultural wage is too high compare to the marginal productivity in the farm and therefore the household does not hire labor. However, the family does not supply off-farm labor because the off-farm wage is too low.
This "autarky" case is only possible when $L_f \geq L^*$, i.e. the optimal farm labor input is lower or equals the family labor supply. If $L_f > L^*$ this is a common case of "underemployment" or surplus labor. In a case of perfect market, only $L*$ would have been employed since this quantity maximizes the profit. Yet, given imperfect market and since the off-farm opportunity has insufficient return, family members prefer work on-farm.

- Second case: $L_o > 0$ and $L_h = 0$, the household supplies some off-farm labor but does not hire labor.

From (*10*), $L_o > 0 \Rightarrow w_o = MRS_{l/C}$ and from (*15*), $L_h = 0 \Rightarrow w_a > \frac{1}{\alpha} MRS_{l/c}$.
From (*13*), the optimal farm labor demand is: $p.F'_L = \frac{\lambda_3}{\lambda_2}$.
Therefore, in this second case, the optimal repartition implies that household supplies off-farm labor from the point where $p.F'_L = \frac{\lambda_3}{\lambda_2} = \frac{1}{\alpha} w_o$ (the optimal labor on farm) to the point $w_o = MRS_{l/C}$ (where household does not want supply additional labor).
Besides, household does not hire labor. Indeed from (*13*), $p.F'_L = \frac{\lambda_3}{\lambda_2}$ and from (*15*) : $w_a > \frac{\lambda_3}{\lambda_2}$, we get: $p.F'_L < w_a$. Therefore, the agricultural wage is too high to make optimal the use of additional hired labor in the farm . Hence, all the farm labor is supplied by the family.

- Third case: $L_o = 0$ and $L_h > 0$, the household supplies only family farm labor and hires labor.

From (*11*), we know that $L_o = 0 \Rightarrow w_o < MRS_{l/c}$ and from (*14*), $L_h > 0 \Rightarrow w_a = \frac{1}{\alpha} MRS_{l/C}$
Therefore the off-farm wage is too low to be attractive for family members. Besides, the optimal farm labor input is such as:
$p.F'_L = \frac{\lambda_3}{\lambda_2} = \frac{1}{\alpha} MRS_{l/C}$. By substituting $MRS_{l/C}$ from(*14*), we get: $p.F'_L = w_a$. The household supplies family labor until $p.F'_L = MRS_{l/C}$ and from this point up to $p.F'_L = w_a$, the household hires labor.

- Fourth case: $L_o > 0$ and $L_h > 0$, the household supplies labor off-farm while simultaneously hires labor in farm.

From (*10*), $L_o > 0 \Rightarrow w_o = MRS_{l/C}$ and from (*14*), $L_h > 0 \Rightarrow \alpha w_a = MRS_{l/C}$. Therefore we have a situation such as: $w_o = \alpha w_a$. Household is indifferent between working on the farm or off-farm, and can chose to supply labor off-farm while hiring labor. In this case, we can not determine exactly the allocation. This case with simultaneity of hiring labor and supplying off-farm labor is rather uncommon and, for simplicity, this marginal case will not be taken into account.

The participation in the Esco scheme can affect this repartition in two ways. First, the farm production function can become more labor intensive. This means that, if the quantity of input is similar, this new production function $F_2(.)$ will be such as: $F_2(L, A) < F_1(L, A)$ (thus output quantity decreases with this new production function) and $F'_{2L} > F'_{1L}$. The second possible change with the participation in the scheme is linked to a rise in the output price p (either because of organic premium or because of improvement in cocoa quality).

We know from (*13*), that the optimal labor demand for farm production is such as: $p.F'_L = \frac{\lambda_3}{\lambda_2}$. As a result, these two possible changes - an increase in p or in F'_{L} - act in the same way on the decision of labor supply and demand.
If the ratio $\frac{\lambda_3}{\lambda_2}$ remains constant, labor demand in the farm increases unambiguously after such change[24]. Besides, since w_o is exogenous, we get from the first order conditions a change in the repartition of the household labor supply. If there is only an increase in the output price p, household may decide to only increase their consumption of leisure and thus this may lead to a decrease of the labor family supply. Yet, family members may also decide to work more (and decrease their leisure) or to work the same quantity but allocating more labor in the farm and less off- farm. Therefore, the final effect typically depends on $\lambda_1, \lambda_2, \lambda_3$ that are respectively the shadow price of time, consumption and labor.

As a result, if labor demand increases due to organic contract farming, we should see empirically change going in this direction such as: increasing family farm labor and/or rise in hired labor, decrease in off-farm supply and/or leisure consumption. The finale effect depends on the initial case (case 1 to 3) and on these shadow prices.

This model is very simple, and aims only to give the main intuitions.[25]. Yet, before the empirical investigation, I need to introduce the concept of "exchange labor" that I will use afterward. "Exchange labor" is simply an arrangement between farmers about the provision of labor that does not involve payment in cash or in kind. The household supplies labor in other farms in exchange of labor in their own farm. As far as I know, any agricultural household model has introduced exchange labor into the modelisation. In fact, most of literature simply ignores the question since determinants of exchange labor are ambiguous and mainly dependent on social factors (Gilligan, 2004).

6. Methodology for empirical investigation

Data collection

Data come from two rounds of survey, the first one in 2005 and the second one in 2009. They have been collected by Gibbon, Lin and Jones. This survey provides respectively data on 55 households in 2005 and 167 in 2009. As a result my estimates are based on a small sample size. I will detail in this part the process for the 2005 survey. Even though I do not possess detail of the methodology for the second round, they have processed in a similar way. Households surveyed in 2009 are not similar to those of the first round but have been selected following similar methods.

In 2005, cocoa producers in the Bundibugyo district are about 8-10,000. Around half of them are localized in four parishes[26]. Two of them, Burondo and Ngamba, are the two parishes selected by the Esco scheme. The other two parishes are Mirambi and Busaru and are made up of traditional farmers, neither organically certified nor members of any contract farming scheme. As sampling frame, six villages from these four parishes have been used. Initially, all villages of each parish were listed and then categorized into one of three altitude bands. Then, one "organic" and one "traditional" villages were randomly chosen from each altitude band. Within each of these six villages, systematic sampling was used to select 10 households for interview. This systematic sampling was done based on a list of certified households provided by Esco or on a list provided by village leaders for the "traditional" villages. They were asked to provide the name of "all cocoa-growing households, rich and poor". The sample from the "traditional" villages is the control group that I will use in the empirical investigation. A detailed questionnaire has been addressed to the household's head and covered a large set of information including household demographics, revenue, farm characteristics, etc. In a few cases, household's head were unavailable and their spouse were instead interviewed. In two or three cases in both groups, where spouse was also unavailable, substitute household was used by taking the

[24] Yet, if the ratio $\frac{\lambda_3}{\lambda_2}$ increases in the same proportion - or relatively more - than $p.F'_L$, this is possible that farm labor demand does not increase.

[25] Limits of this model are multiple but since its really modest aim, simplicity is paramount. One limit is that household members are treated as homogenous while this does not fit with evidences. For instance, Bagamba et al.(2009) found in their study in Uganda that a rise in the output price leads to an increase in the husband's labor supply while this has a negative impact on wife's work effort – since they do not control the benefit of farm work. On the contrary, Gibbon et al. (2008) find that this is the wife that increases the labor supply in the farm. As a whole, evidence agrees about the heterogeneity between household members that is not taken into account in this model.

[26] These estimates have been done by Esco and Bundibugyo district agricultural office.

household's name that was listed immediately after those originally chosen. An important and limiting point for my topic is that survey did not collect data on family labor input. Indeed, this is common in farm-budget related survey in Africa because of three main reasons (Bolwig et al, 2009). First, households find more difficult to recall family labor input than hired or exchange labor ones. In addition, they have difficulty to attribute accurately time values for some labor tasks done only by family (such as supervision). At last, this is not accurate to attribute a common metrics for labor done by children and by adults. This survey has not been done for my specific focus and therefore this is not surprising that data limits my empirical investigation.

Descriptive statistics

The sample is constituted by 55 households for the 2005 survey round with 28 certified and 27 control households and by 167 households, with 89 certified and 78 control ones, for the 2009 survey round. By comparing the mean value of some key variables (Table 1) we see that, among other things, the number of organic practices is higher for organic certified farmers. Yet this is striking to observe that firstly, the adoption of organic practices has been particularly low and secondly, that certified organic farmers decrease the use of organic practice over time. This is of course limiting since some key benefits of organic agriculture stem from these practices. For my focus this may also be limiting because with so little information, variation may be insufficient to identify and quantify the effect of organic practices on labor input. We also notice that certified households are relatively larger (due to both a larger number of members above and under 6 years old) and has a older household's head. They also have slightly bigger farms, with more productive cocoa trees and vanilla vines. Therefore, econometric estimate has to control for these household characteristics. Their total gross crop revenue as well as their net cocoa revenue is also significantly higher[27]. In addition the share of cocoa that is fully or semi-fermented and the average price are significantly higher and increase over time for both groups. Besides, certified farmers are relatively less specialized in cocoa and vanilla, even though this specialization increases highly over time.

Hypothesis

The goal of this empirical analysis is to determine whether or not the participation into the Esco organic contract farming scheme increases the farm labor demand. Therefore the main hypothesis is:

Hypothesis I – After controlling for relevant determinants, there is a significant difference in farm labor input between certified and non-certified farmers.

Yet, I will go further by trying to determine what the channels of this increase in labor demand are. I will therefore test three sub-hypotheses:

Hypothesis I-a. – After controlling for relevant determinants, this difference in farm labor input is explained by the organic price premium offered to the certified farmers.

Hypothesis I-b. – After controlling for relevant determinants, this difference in farm labor input is explained by the higher quality cocoa supplied by certified farmers.

Hypothesis I-c. – After controlling for relevant determinants, this difference in farm labor input is due to a higher use of organic farming practices that are labor intensive.

Analytical method

For this empirical estimation, we are facing several challenges. The main one is to evaluate the effect of the participation in the scheme without selection bias. Indeed, the setting of this scheme is non-experimental and thus participation cannot be assumed purely random. In fact, there are three potential sources of selection

[27] see Gibbon and Jones (2011) for a rigorous studies about the effect of certification on these variables.

Table 1: Descriptive statistics

2005

Variable (means)	Unit	Certified	Non certified	test
Respondents	count	28	27	
Number of organic practices	count	1.1	0.1	-4.6***
Age of household head	years	50.4	41	-2.6***
Household member >6 yrs old	count	7.5	5.7	-2.5**
Dependent (< 6 yrs old)	count	2.8	2	-1.2
Persons in household	count	10.3	7.7	-2.5**
Size whole farm	ha	2.45	2.12	-0.7
Productive cocoa trees	count	1302.1	1280.6	-0,4
Productive vanilla vines	count	16.6	11.6	-1.6**
Total gross crop revenue	1000 USh	1507	995	-1.7**
Net cocoa revenue	1000 USh	1185	640	-2.2**
Cocoa revenue in total revenue	percent	87.6	97.5	2.6***
Other crops in total crop revenue	percent	6.9	1.6	-1.5
All equipment cost	1000 USh	25	39	1.5
Cocoa fully or semi-fermented	percent	74.6	46.8	-2.1**
Cocoa price	1000 USh/kg	1.3	1	-3.5***

2009

Variable (means)	Unit	Certified	Non certified	test
Respondents	count	89	78	
Number of organic practices	count	0.6	0.5	-0.7
Age of household head	years	48.7	38.6	-4.7***
Household member >6 yrs old	count	6.1	5.5	-1.6
Dependent (< 6 yrs old)	count	1.9	2.3	1.7*
Persons in household	count	8	7.8	-0.4
Size whole farm	ha	2.47	2.41	-0.5
Productive cocoa trees	count	1323.4	1276.8	-1.7*
Productive vanilla vines	count	180.7	34.9	-5.6***
Total gross crop revenue	1000 USh	1854	766	-7.1***
Net cocoa revenue	1000 USh	1643	589	-7.8***
Cocoa revenue in total revenue	percent	93.5	92.2	0,9*
Other crops in total crop rev.	percent	0.8	4.1	2**
All equipment cost	1000 USh	40	50	-1.7*
Cocoa fully or semi-fermented	percent	98	65.7	-8.2***
Cocoa price	1000 USh/kg	2	1.7	-8***

Note: "Net cocoa revenue" is the gross sales revenue minus the variable cost of labor and equipment. "Other crops" indicates crops other than cocoa and vanilla ones. "Cocoa price" is the average price received by producers. "Cocoa fully or semi-fermented" is the share of this type of cocoa on total cocoa production.

bias. Firstly, the programme placement has been chosen by Esco's managers. Hence, this endogenous placement has to be taken into account. Secondly, all producers from these selected parishes have chosen whether to participate or not in the scheme. Such decision may be linked to household's specific characteristics such as lower risk aversion, more entrepreneurial mind, etc. Thus, these households may be more incline to hire more labor, regardless of their participation in the scheme. Thirdly, there is a geographical heterogeneity. Among other things, soil productivity or access to road and other infrastructures can play a significant role. If certified farmers are those owning the most fertile lands, they intrinsically need to use more labor input, and this should not be confounded with the effect of participation that I want to evaluate.

As a result the evaluation problem can be expressed by a system of equations that represents the outcome of interest (y) and a selection equation for treatment (t) over observation i such as:

$y_{1i} = x_i'\beta_1 + \mu_{1i}$ *(1)*
$y_{0i} = x_i'\beta_0 + \mu_{0i}$ *(2)*
$t_i = 1(z_i'\beta_1 + v_i > 0)$ *(3)*

The equation *(3)* - the selection equation - is an indicator function that takes the value 1 for treated household for which $z'\beta_1 + v_i > 0$ and 0 otherwise. The selection factors correspond to z_i and explain the participation. y_{1i} is the outcome for treated respondent for which $t_i = 1$ and y_{0i} is the outcome for control household for which $t_i = 0$.

This system can be summarized by :
$y_i = x_i'\beta_0 + t_i x_i'(\beta_1 - \beta_0) + \mu_{0i} + t_i(\mu_{1i} - \mu_{0i})$ *(4)*

Besides, I will assume that treatment effect is only through the intercept of the joint outcome equation (thus treatment does not affect the slope of the regression line) such as : $\beta_1 = \beta_0 = \beta$. This common assumption is reasonable is my case since the scheme is relatively recent and thus, there is a strong similarity between the control and treatment groups. This leads to the reduced form:
$y_i = x_i'\beta + t_i\alpha + \mu_{0i} + t(\mu_{1i} - \mu_{0i})$ *(5)*
where α captures the treatment effect that represents the difference in intercept due to treatment.

Controlling fully and directly for all sources of bias in the estimation is an efficient way to address selection problem. To make realistic such identification procedure, all elements that explained this endogenous selection have to be observable and included in the regression. Nevertheless, this is possible that these elements are not fully observable in the data. If this is the case, econometric approach has to correct this bias. One way to address this issue is to find valid instruments for scheme participation and to use an instrumental variable (IV) approach[28].

Given the three potential sources of bias, I will use two instruments to control for the participation in the scheme when this will be required. One instrument is controlling for the endogenous placement and geographical heterogeneity and another one is controlling for household characteristics. The first instrument is the variable called *'Village'* that takes a value between 1 and 30 depending on which village the surveyed household comes from. Indeed, this is relevant to chose an instrument for location characteristic given that only inhabitants of eligible places have the possibility to join the scheme. Besides, the village level is appropriated since geographical heterogeneity within the same village is likely to be small. Given its limited size, soil fertility or access to infrastructure for instance are likely to be rather similar. Nevertheless, since Esco has selected parishes (that consist of several villages), it is legitimate to be worried between a collinearity between a dummy variable that represents the participation in the scheme – *'Certification'* the main regressor of interest – and this location variable *'Village'*. Indeed, given the free entry into the scheme, we may think that almost all inhabitants of selected places are certified and therefore this instrument 'Village' can not be used. Yet, correlation between the two variables is about - 0.45 and variance inflation factor does not indicate anything worrying[29]. As a result, living in a selected parish does not automatically imply to be a certified farmer, even though this is a necessary condition. This instrument can thus control properly for the placement and geographical bias. The second instrument is a dummy variable, called *'Education'*,

[28]For literature about instrumental variables, see for instance Baum et al. (2007), Cameron and Trivedi (2005; 2009, chap. 6), Davidson and MacKinnon (1993, 2004), Greene (2008, chap. 12), and Wooldridge (2002, 2009).
[29]The tolerance (1/VIF) is 0.7965 and the mean VIF is 1.26.

that takes the value 1 if the household's head has received schooling at the primary level. This variable may capture some household characteristics that explain the participation in the Esco scheme. Of course, these two instruments are only proxy for the three sources of bias but they are well correlated with the main regressor of interest ('*Certification*') and should not be related to the other variables (dependent and regressors) of our model[30].

The empirical investigation will be separated in two parts: the first one will investigate about hypothesis I, and the second one about hypotheses I- a. b. c. I will study four dependent variables that give indications about the farm labor demand, namely the total labor cost, the dummy variable indicating if the household hires labor, the number of household members that are working off-farm and the dummy variable that indicates practice of exchange labor. Given these are continuous, binary and count variables, different econometric approaches will be used and I will explain them each time. As far as it is possible, I will use alternative estimation method in order to ensure the robustness of my result.

7. Empirical estimation

A. Evaluation of participation in the Esco scheme on labor demand

a. Labor cost

The first dependent variable is the total farm labor cost of producers. This labor cost includes payment for hired labor that is used for harvesting, weeding, planting and other preparatory works. In addition, this also includes the value of exchange labor for harvesting and weeding, that are the usual tasks for this kind of labor. This exchange labor does not provide cash payment but reference wage rate for similar work can easily be taken. Besides, no estimate has been done about family labor cost. As common in farm survey, there is no try for doing so since households have typically great difficulty to recall their labor input. In addition, there is an absence of reference materials for wage rate for tasks such as supervision or monitoring that are almost never done by hired labor. This is obviously limiting, but we can still have very useful information on external labor input through this variable.

For the empirical implementation, a set of regressors about characteristics will be used. These regressors potentially affect the farm labor cost and we have to control for. These are: the logarithm of the farm size (acres), the age of the household's head, a dummy variable taking the value one if the household's head is a male and another one to know if all the household members work on the family farm. This is justified since family that does not supply off-farm labor may exhibit some specific characteristics. I also control for the number of dependent household members (i.e. members of less than 6 years old), the number of household members working within the farm as main occupation, the share of revenue that does not come from vanilla or cocoa (i.e. we control for the specialization into the crop production concerned by the Esco scheme), the period and the number of organic practices. The survey informs about the four more common practices, namely the use of manure, bio-pesticides, mulching and soil conservation practices. Other practices exist but they are likely to be very marginally used either by certified or by control farmers. In addition, the main regressor of interest ('*Certification*') is a dummy variable taking the value one if producer is certified (i.e. participate in the organic contract farming scheme). All prices used in this study are expressed in 2005 prices. They have been deflated using Consumer Price Index, Mbarara for all items (Ubos)[31].

Despite there is *a priori* an endogeneity issue with the 'Certification' regressor due to the three sources of bias specified earlier, I have to verify whether this issue can significantly bias my result. After running a simple OLS regression, a Durbin–Wu–Hausman test (Wu, 1974 and Hausman, 1978) confirms that the variable *'Certification'* is endogenous and biases estimate. I also run tests in order to ensure the validity of my regression[32] as well as a White (1980) test for heteroskedasticity. The null hypothesis of homoskedasticity is rejected (p-value equals 0.05). Hence, this is another source of potential bias that has to be corrected.

[30] In addition, each time I use these instruments, various tests are done in order to ensure their adequacy. All tests indicate that they are good instruments and they enable to correct for endogeneity bias of '*Certification*'.

[31] All prices are expressed in Ugandan Shillings (USh). For 2005, the average exchange rate was US$1 = 1778 USh)

[32] The general Ramsey Reset specification test for the linear regression (Ramsey, J.B, 1969) confirms there is no apparent issue about the specification. Correlogram of all our explanatory variable does not appear worrying at all (the higher correlation is as low as 0.33).

As a result, an IV approach seems adapted in this case for correcting endogeneity of 'Certification'. Formally, the model can be defined by:

$LabCost_i = Certification_i \beta_1 + x_{1i}\beta_2 + \mu_i$ (1)
$Certification_i = x_{1i}\gamma_1 + x_{2i}\gamma_2 + \varepsilon_i$

Where *LabCost* represents the total labor cost, *Certification* is the endogenous regressor, x_{1i} represents the included exogenous regressors and x_{2i} represents the excluded exogenous regressors (namely *Education* and *Village*). The error terms μ_i and ε_i have a mean equal to zero but the correlation between μ_i and ε_i is presumably nonzero.

As instrumental variable (IV) approach, a limited-information maximum likelihood (LIML) estimation will be used. Indeed the LIML estimate has the same asymptotic distribution than the common two-stage least-squares one (2SLS) but has better small sample properties[33]. Given the small sample size, this instrumental variable (IV) approach is the most adequate for this sample. Nevertheless, since LIML is basically a linear combination of the OLS and 2SLS estimates – weighted in such way that it reduces the 2SLS bias – usual assumptions for OLS should not be violated to ensure consistent estimate. As a result, using a robust standard error[34] with a LIML estimate seems adapted at this situation.

Table 1: Effect of certification on total labor cost

	LIML		Two step	
main				
Certification	66.58^{+}	(1.64)	64.86^{+}	(1.62)
Practice	-36.20^{+}	(-1.78)	-32.19^{+}	(-1.91)
Period	74.86*	(2.10)	91.42**	(2.86)
Hh_farmlab	-10.34	(-0.39)	2.188	(0.08)
Hh_depend	5.733	(0.93)	4.389	(0.65)
Farm_size	210.9***	(8.88)	206.0***	(9.22)
Age	-3.511***	(-3.44)	-3.510***	(-3.50)
Male	-117.1*	(-2.29)	-112.4^{+}	(-1.94)
Farmonly	-67.39^{+}	(-1.90)	-67.70*	(-1.97)
Revshare_othrcrop	1.388	(0.80)	1.327	(0.92)
_cons	228.6*	(2.49)	201.0*	(2.07)
Certification				
Village			-0.0222^{+}	(-1.65)
Education			-6.375	(-0.03)
Farm_size			0.337^{+}	(1.77)
Age			0.0295***	(3.60)
_cons			4.182	(0.02)
hazard				
lambda			-94.73**	(-2.93)
N	220		220	
R^2	0.375			
adj. R^2	0.346			

t statistics in parentheses

Notes: The first level of significance is set at 11 percent because the p-value given for 'Certification' is p = 0.102.

The dependent variable is 'LabCost'.

Sources: Author's calculation, using Stata 11.

$^{+}$ $p < 0.11$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[33] See Flores-Lagunes (2007) for an extensive Monte Carlo study that suggests that LIML does at least as well as all the others alternatives in a broad range of circumstances.

[34] For robust standard error, Stata 11 uses by default the Newey-West (1987) standard error. This is an extension of the classic Huber/White/sandwich robust variance estimator (White, 1980) that also produces consistent estimates when there is autocorrelation.

This first estimation indicates that the participation in the scheme has a positive effect on the labor input cost of producers. The p-value is 0.102, which can be round up to 0.10, thus we can conclude that this result is significant at 10 percent level[35]. Most coefficients exhibit expected sign. For instance, the size farm as a strong significant effect on the labor input cost while the fact to be a male's headed household decreases it. Yet, two important points can be stressed. First, the number of organic practices has a negative effect on labor cost. This is rather contradictory on what is expected. However, as already stressed, the adoption of these four main kinds of organic practice (mulching, bio-pesticide, manure and soil conservation practice) is extremely low. The average number of practices in 2005 and 2009 is respectively 0.51 and 0.53 and this is possibly too little to provide reliable information. If there is not enough variation in the variable, econometric estimate faces difficulty to provide meaningful result. The second point is that *'Period'* has a positive effect on the total labor cost. Despite prices have been deflated with the Consumer Price Index (Ubos), producers in 2009 spend more than those in 2005. There are various explanations but one of them is that control farmers have benefit of spillovers from the Esco scheme. Processing techniques for instance have been increasingly spread among them (Gibbon and Jones, 2011), and the output price has therefore risen due to higher quality and perhaps higher competition for middlemen that bought cocoa to farmers. The presence of Esco scheme in the region is likely to have influenced these factors (see Gibbon and Jones, 2011) and this may explain the general higher use of external labor through time.

In order to ensure the robustness of this result, I will use an alternative estimation method: a treatment-effects model. This approach tries to get efficiency gain by using a different modeling of the equation system. Here, the binary endogenous variable (*'Certification'*) is estimated with a probit method. This is the usual robustness-vs-efficiency tradeoff. If the probit equation is correctly specified then this estimate will be more efficient than the IV approach. If this is mispecified, treatment effects estimate will be inconsistent (while IV estimate is consistent in both cases). Besides, treatment-effects model can be used either with a two-step consistent estimates or with the full maximum likelihood. The latter one (called also FIML estimate) assumes that errors of the two equations (selection and outcome equations) are jointly normally distributed. If this is true, estimator is consistent and efficient. If not, this is not consistent anymore. On the contrary, the two-step approach (called also two-step Heckman model) does not do this demanding assumption about joint normality and therefore is much more often consistent. Yet, this estimate will be inefficient if indeed this assumption is true. Consequently, I think a two-step treatment effects model is a good trade-off between efficiency and consistency and provide an interesting alternative to the first estimate. The selection equation is made of the two excluded instruments (*'Education'* and *'Village'*), *'Farm_Size'* and *'Age'* [36]. This second estimate provides results that are very close to the first one and confirms its robustness. As a result, these estimates indicate that participation in the organic contract farming scheme has a significant positive effect on the cost of hired and exchange labor in the farm.

b. Use of hired labor

The second dependent variable is a dummy variable indicating whether the household hires labor or not. We expect that participation in the scheme creates employment opportunities and therefore one possible manifestation of this can be through a positive effect on this dependent variable. For this second regression, almost similar regressors are used in order to control for household's characteristics. However, a different econometric approach is required since the dependent variable is now a binary variable and not a continuous one as previously. For such dependent variable, a probit estimate is better suited than OLS approach. The goodness-of-fit test confirms that a probit model is adapted for this estimation. Besides there is no collinearity problem and heteroskedasticity of error terms is not significant[37]. In order to assess the endogeneity of *'Certification'*, a Smith-Blundell test of exogeneity[38] is done. Since the null hypothesis of exogeneity is accepted, endogeneity should not significantly bias my estimate. As a result a simple probit regression should

[35] The variable *'CostLab'* is the square root of the total cost of all labor. Therefore, participation in the organic contract farming scheme is associated with an increase in the labor cost of $(66.58)^2$, i.e. of 4 432 USh per year.

[36] Introduction of the other explanatory variables is not particularly relevant. Indeed, when I do so, coefficients of these additional variables appear to be highly insignificant. Besides, a reverse causality is also possible in the case of the number of organic practice for instance. Nevertheless, even with the introduction of other variables, I obtain very similar coefficient.

[37] No formal test has been run but coefficient estimates are exactly similar with or without the robust standard errors option. Thus, heteroskedasticity does not significantly bias result. The goodness-of-fit test is provided with the command -estat gof- (Stata 11).

[38] The exogeneity test is given by the command –probexog-.

provide an adequate estimate. As an alternative approach, I decide to control for this potential endogeneity bias of *'Certification'* – even though this bias should not be significant according to the Smith-Blundell test. Usual IV approach is only for continuous dependent variable and the IV probit approach through Maximum likelihood estimation fits only for continuous endogenous variable. In such case, Greene (2000, pp.852-855) has clearly shown that doing the estimation jointly via a bivariate probit is an adequate way to solve the endogeneity problem. Therefore I will use a bivariate probit estimation as alternative approach[39].

Table 2: Regression result for the effect of certification on the use of hired labor

	Probit		Bivariate probit	
HireLab				
Certification	0.689$^+$	(1.91)	0.819$^+$	(1.84)
Period	-0.440	(-1.06)	-0.402	(-0.95)
Practice	-0.231	(-1.51)	-0.228	(-1.49)
Hh_farmlab	-0.675*	(-2.16)	-0.660*	(-2.12)
Hh_depend	0.0685	(1.04)	0.0653	(0.98)
Cocoa_trees	1.243***	(4.82)	1.232***	(4.75)
Vanilla_vines	0.0564	(0.36)	0.0559	(0.36)
Age	-0.0312**	(-3.14)	-0.0320**	(-3.19)
Male	-0.135	(-0.21)	-0.116	(-0.18)
Farmonly	-0.546	(-1.50)	-0.537	(-1.48)
Revshare_othrcrop	0.0234	(1.50)	0.0244	(1.55)
_cons	-5.580**	(-3.07)	-5.633**	(-3.09)
Certification				
Village			-0.0407*	(-2.04)
Education			-6.910	(-0.00)
Farm_size			0.546$^+$	(1.83)
Age			0.0164	(1.22)
_cons			5.373	(0.00)
athrho				
_cons			-0.196	(-0.48)
N	130		130	

t statistics in parentheses

Notes: Cocoa_trees and Vanilla_vines represent the logarithm of the number of productive cocoa trees and vanilla vines.

Sources: Author's calculation, using Stata 11.

$^+$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

With a p-value of 0.057, the coefficient of *'Certification'* is significant at 10 percent level. Thus, this regression indicates a positive effect on the fact of using hired labor for certified farmers. Probit estimate does not provide very intuitive result and this probit estimate has been done to see the sign of the coefficient rather than quantifying this effect[40]. The significant positive effect is also confirmed by the alternative estimate. As a result, the participation in the Esco scheme significantly increases the probability of using hired labor. Intuitively, this is in line with the hypothesis that organic contract farming scheme increases labor requirement and creates employment opportunities. Of course, this is not a rigorous proof of that since more producers can have use hired labor but, as a whole, less labor can be hired. Yet, with the previous result this may be a useful indication.

[39]Bivariate probit estimation is given by -biprobit- (Stata 11).

[40]Indeed given the small sample size and given the purpose of this study, I think we should not put too much weight to the exact coefficient provided by this probit estimation. Yet, the coefficient is about 0.69 thus, this implies that a one standard deviation increase in the '*Certification*' variable produces a 0.2199 standard deviation increase in the underlying latent variable *'HireLab'*. The 0.2199 is given by the column bStdXY after doing the command -listcoef- following the probit estimation.

c. Use of exchange labor

The first estimation has found that the total cost of labor input (exchange and hired labor) increases with the participation in the contact farming scheme. As a result, this increase may have been done through the rise in exchange labor, hired labor, or both. Last result seems support the increase in the hired labor and this may be interesting to examine the change in exchange labor use. Since the dependent variable *'ExchLab'* is also a dummy variable, the same econometric approach as *'HireLab'* can be used. The goodness-of-fit test is good, correlations between regressors are low and error terms seem homoskedastic. A Smith-Blundell test indicates the exogeneity of *'Certification'* and thus a simple probit estimation is the most adequate method. As alternative approach, I use a bivariate probit (or 'biprobit') because if, despite the Smith –Blundell test, endogeneity biases the probit estimate, the biprobit one will be more adequate.

Table 3: Effect of certification on the use of exchange labor and on the number of household members woking off-farm

	Probit		Bivariate probit		IV Poisson	
main						
Certification	-0.610*	(-2.25)	-0.658+	(-1.65)	-0.239	(-0.37)
Period	0.460	(1.46)	0.455	(1.43)	0.515	(0.94)
Practice	0.192	(1.33)	0.193	(1.34)	0.721**	(3.03)
Hh_farmlab	-0.302	(-1.24)	-0.303	(-1.24)	-0.212	(-0.54)
Hh_depend	0.0351	(0.58)	0.0356	(0.59)	0.0629	(0.59)
Farm_size	-0.124	(-0.62)	-0.120	(-0.59)	-0.200	(-0.61)
Age	-0.00760	(-0.93)	-0.00700	(-0.78)	0.00216	(0.13)
Male	0.278	(0.48)	0.278	(0.48)	-0.633	(-0.65)
Farmonly	0.336	(1.03)	0.332	(1.02)		
Revshare_othrcrop	0.00428	(0.33)	0.00412	(0.32)	-0.0244	(-0.83)
_cons	-1.038	(-1.14)	-1.038	(-1.14)	-1.149	(-0.63)
Certification						
Village			-0.0220	(-1.63)		
Education			-7.257	(-0.00)		
Farm_size			0.337+	(1.77)		
Age			0.0295***	(3.61)		
_cons			5.062	(0.00)		
athrho						
_cons			0.0633	(0.16)		
N	220		220		220	

t statistics in parentheses

Notes: The dependent variable for the Probit and Biprobit regression is 'HireLab'.

The dependent variable for the IV Poisson regression is 'Hh_nonfarmlab'.

Sources: Author's calculation, using Stata 11.

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The negative coefficient for the variable *'Certification'* implies that certified farmers are less involved in exchange labor system than control farmers. The p-value associated to this coefficient is 0.025 and therefore this result is significant at the 5 percent level. The biprobit estimate also provides a significant negative coefficient at the 10 percent level. Therefore, whatever the significance of the bias due to the non-random participation in the scheme, this participation has a significant negative effect on the likelihood of using exchange labor.

Exchange labor has been little studied in the literature (Gilligan, 2004) and therefore I do not have the exact keys to properly interpret why the participation in the scheme may have this negative effect on the exchange labor. However, sociologists such as Erasmus (1956, 1961) have stressed that one of the primary determinants of this arrangement is to avoid cash payment. In this case, this may be a possible explanation. Nevertheless, the important information provided by this regression is not here. If we assume that this dummy variable is a good indicator of the general use of exchange labor – i.e. *'Certification'* is also associated with a lower quantity of exchange labor input – this implies that the total rise in labor cost is only justified by a much higher use of hired labor since exchange labor use has declined in the meanwhile. Of course, I recognize that results obtained in these last two regressions (with *'HireLab'* and *'ExchLab'* as dependent variables) do not necessarily imply such conclusion. Certified farmers using exchange labor may have increased the quantity of exchange labor input while some of them have stopped using this kind of arrangement. However, I think this is indicative and gives a tool to interpret the first result. Intuitively, this result is in line with the expectation that organic contract farming increases labor demand but also creates employment opportunities.

d. Number of household members working off-farm

Hired and exchange labor are the only ones to be valued and quantified in this survey. However, the main labor input in household's farm comes from the family members. If farm labor demand increases, one possible expression of this increase is through a rise in the family labor input. They may increase their farm labor either through decreasing their leisure or their off-farm labor time. The last variable that I will examine is thus the number of household members that are working off-farm. This may provide indication about how their labor allocation is affected and this may support the hypothesis that organic contract farming increases the labor demand.

Since the dependent variable is a count variable, a Poisson estimation may potentially be used. Yet, the Poisson distribution assumes that its means equals its variance, and this is a very strong assumption. Nevertheless, the goodness-of-fit test confirms that Poisson distribution is well adapted here. We also test for the exogeneity of *'Certification'* with a Durbin–Wu–Hausman test. At the 5 percent level of significance, the null hypothesis of exogeneity is rejected and therefore endogeneity significantly bias result with a simple Poisson estimation. As a result, I will use an IV approach adapted for a Poisson distribution[41]. For this regression, the regressor *'Farmonly'* has been dropped off. Indeed this dummy variable does not have any sense for explaining the number of household members working off-farm. Since the dependent variable is a count variable and there is an endogenous binary regressor, no alternative regression is proposed. As far as it is in my knowledge, no other approach is adapted in such case.

The coefficient for *'Certification'* provided by this regression is highly insignificant. The p-value is 0.709 and therefore it seems that participation in the scheme does not significantly impact the dependent variable. Nevertheless, the coefficient is negative and therefore the participation in the scheme may tend to decrease the number of household members working off-farm. Yet, data are relatively imprecise since this dependent variable only counts members having a primary occupation that is not in the farm. This does not mean that these members do not work at all on farm. By itself this estimate is not meaningful for drawing any conclusion. However, it may be useful to stress that, in the literature, there is absolutely no qualitative evidence that family decreases their farm labor input with organic farming. On the contrary, several studies, including the ones in Africa, report that farmers have increased their load of farm work (See section 3). As a result this negative sign, added with the three previous regressions, goes toward supporting the main hypothesis.

To conclude, a significant positive effect from the participation in the Esco scheme on the labor cost has been rigorously shown. This first estimation provides the main support for accepting Hypothesis I. Besides, certified farmers are significantly less engaged in the exchange labor system while more engaged in the hiring of labor. This is not a rigorous proof but these two results seem indicate that certified farmers use less exchange labor while using more hired labor than non-certified ones. In such case, their higher total labor cost – made of exchange and hired labor - consists of lower exchange labor cost while appreciably higher hired labor one. This supports the idea that organic contract farming creates employment opportunities. Unfortunately, not much can be say about the family labor input. The participation in the scheme decreases the number of household members working off-farm but this finding is not statistically significant. As a whole, all these empirical findings – in particular the one given by the first regression – go toward accepting the Hypothesis I:

[41] This is a Generalized Method of Moments estimator (Mullahy, 1997) of Poisson regression given by the command –ivpois-. This is not an official Stata command. See Nichols, Austin. 2007, ivpois: Stata module for IV/GMM Poisson regression: http://ideas.repec.org/c/boc/bocode/s456890.html.

After controlling for relevant determinants, there is a significant difference in farm labor input between certified and non-certified farmers.

B. Channels through which Esco scheme increases labor demand

The previous part has brought support to the main hypothesis. Yet, this is interesting to detail how the participation in the scheme affects labor demand. In this part, I will focus on the sub-sample of certified farmers in order to understand these channels[42]. Theoretically, three main changes associated with this participation can impact the labor demand.

The first possible effect is due to the use of organic farming practices. These practices are also used by non-certified farmers but certified farmers have received specific formation and advice about them. Thus they are more likely to use them and maybe they do not process in the same way as non-certified farmers. The common idea is that organic farming practice is labor intensive. In the whole sample, I have failed to find any support of this idea and on the contrary, organic practice seems have a negative effect on the total labor cost. Yet, this channel – in theory – is important and I will investigate further this point in the sub-sample of certified farmers. The second possible effect comes from economic incentive. By receiving a higher output price, producers may have incentive to increase their production. From the simple farm-household model, main intuition can be drawn. Higher output price may lead to a substitution effect by increasing the leisure consumption. Nevertheless this may also give incentive to increase output production, either by reallocating more family labor into the farm or by using external labor as additional input. In fact, there is considerable evidences in the literature that producers respond positively to price change by increasing the production (and thus associated input use)[43]. Qualitative evidences on organic contract farming in Uganda go also toward this conclusion (Gibbon et al. 2008, Bolwig et al. 2009). As a result, *a priori*, higher output price should contribute to explain the increase in labor demand. However, this higher price received by scheme member has two principal sources: a pure "organic premium" – coming from the organic certification itself – and a "quality premium". Organic product has to satisfy high quality standards and this quality – even without organic certification – gives access to a higher price in the conventional market. The third possible change that may explain the rise in labor demand is the upgrading of the quality. Besides giving access to a better price, higher quality cocoa – with beans that have been fully or semi fermented and dried in the sun – requires some production inputs. This requires time of course, but this may also increase labor input. As a result, it may be interesting to see whether processing the cocoa beans significantly impacts labor demand. Nevertheless, there is here an important econometric challenge. How can we disentangle the "price" incentive and the "processing" effect? The Esco's "price premium" is only paid when the cocoa has been processed. Therefore, higher quality beans may increase labor input either by higher labor requirement (due to processing) or because of higher incentive (due to higher price). Econometrically this is obviously an important issue. This is not possible to investigate into the same regression the "price" and the "processing" effect on a dependent variable, since these regressors are strongly linked and simultaneously determined. I do not have – and I do not think it exists – instruments that can accurately correct for the resulting bias. Besides, the correlation between them is too large (0.77 for this sub-sample), and this would lead to very imprecise estimate.

As econometric approach, I have therefore decided to use the Seemingly Unrelated Regression (SUR) method proposed by Zellner (1962). Two separate regression equations will be estimated. The first one will have *'Price'* and *'Practice'* as explanatory variables, plus usual control variables. The second one will have *'Process'*, *'Practice'* and similar control variables. The variable *'Price'* represents the logarithm of the average cocoa price received by producers. *'Practice'* counts the number of organic practices among the four more common practices (i.e. use of mulching, bio-pesticide, manure and soil conservation practices). *'Process'* is the share of fully or semi-fermented organic cocoa on total cocoa production. The dependent variable will be first, the total labor cost and then, dummy variable indicating if household hires labor[44]. The interest of this approach is simple. Since this is not possible to have *'Process'* and *'Price'* in the same regression,

[42] In the whole sample, estimate results lead to the same conclusion. Yet, coefficient and significance level are usually lower.

[43] See for instance Chhibber (1988), Askari and Cummings (1976) and Schiff and Montenegro (1997)

[44] The dummy variable for the exchange labor does not have great interest for this empirical investigation since exchange labor decreases with the participation in the scheme and is mainly socially determined. Besides the number of members working off-farm can not be used to explain the channels through which the scheme impacts labor demand since the scheme does not significantly affect this variable.

two independent equations are determined. Each of these equations is a correctly specified regression and can be separately estimated. Assumptions done for the estimation method should be verified for each of this regression. However, the error term of each of this equation is assumed to be correlated. Indeed this is greatly possible that unobserved variables included in the error term of the first equation are linked to the ones of the second equation. Since in my case, these two equations are almost similar (only one regressor, *'Price'* or *'Process'*, change), most of what have been omitted in the first equation would also have been omitted in the second one. If errors terms are indeed correlated, a SUR regression will be more efficient – at least asymptotically - than completely independent estimates. Besides, as alternative approach I will estimate independently these two regressions in order to be sure that assumption of correlated errors is not biasing the result. Yet, for all the following regressions, reader has to keep in mind that coefficients associated to the explanatory variables *'Price'* and *'Process'* take into account two effects: the economic incentive as well as a potential higher labor requirement due to processing.

a. Labor cost

The dependent variable is the total labor cost that has been used in the previous part (A.a). Since this is a continuous variable, an OLS estimation for the two equations seems adapted. Yet, tests are required to ensure that underlying assumptions are verified. The general specification test for the linear regression model (Ramsey Reset test) is good, correlation between regressors is low and endogeneity should not significantly bias my result. However, contrary to the White test, the Breusch-Pagan (1979) Lagrange multiplier test informs about the heteroskedasticity of the error terms. For the SUR regression, this is not a problem since this approach uses by default a robust variance estimator[45]. However, for the alternative approach, robust standard error will be used to correct this potential source of inference bias.

For the first equation (including *'Practice'* and *'Process'*): the coefficient of *'Practice'*, of about -39.65, has a negative sign but is not significant (p-value of 0.121). On the contrary, *'Process'* is strongly significant at a 0.1 percent level and has a large positive coefficient of about 239.35. For the second equation (including *'Practice'* and *'Price'*): *'Price'* has a large positive coefficient of about 285.24 that is significant at 0.1 percent level. Coefficients of other regressors are close to the first equation and therefore this supports the adequacy of the specification. The simple OLS estimation with robust standard error provides exactly the same coefficient estimate and this confirms these findings.

As a whole, we can conclude that higher price and higher beans quality cause a strong and significant increase in the external labor demand[46]. On the contrary, the practice of organic farming methods does not have a significant impact on the external labor demand. The negative sign of the coefficient associated to *'Practice'* is counter-intuitive. Yet, given the very low adoption of organic practices, I do not think we should put too much weight on this finding.

b. Use of hired labor

This second dependent variable indicates whether the household uses hired labor. Explanatory variables are the same as previously and since the dependent is a dummy variable, I will use a probit regression with a SUR approach. For the two probit regressions, the goodness-of-fit test is good; there is no collinearity, endogeneity and heteroskedastic issues[47]. As alternative approach, probit regressions will be separately estimated (i.e. without assuming the correlation of the error terms as the SUR method does).

By using a SUR estimation, the coefficient associated with *'Practice'* is negative in both equation but highly insignificant (p-value of 0.545 and 0.535). Besides, *'Process'* affects positively the fact that household uses hired labor at a 5 percent level of significance. *'Price'* also affects it positively and this is significant at a 1 percent level. Other regressors present similar coefficients in the two regression and have expected sign. Simple probit estimates also provide very similar results. While *'Practice'* is still highly insignificant, *'Process'* and *'Price'* are both significant at 5 percent level. These results are perfectly in line with the previous result about total labor cost. If we assume that this dummy gives indication about the trend in the

[45] The SUR regression is given by the postestimation command -suest- (Stata 11).

[46] When the logarithm of the average cocoa price increases of 1 percent, the labor input cost increases of 81,364.2 USh per year. When the share of fully- and semi- fermented cocoa increase of 1 percent, the labor input cost increases of 57,286.8 USh per year.

[47] Hypothesis of homoskedastic errors is tested with the command -hetprob-.

Table 4: Channels of the effect of certification on the total labor cost

	SUR		OLS 1		OLS 2	
main						
Practice	-39.65	(-1.55)	-39.65	(-1.49)	-37.30	(-1.42)
Process	239.3***	(3.37)	239.3**	(3.24)		
Hh_farmlab	-29.89	(-0.80)	-29.89	(-0.77)	-21.30	(-0.56)
Hh_depend	21.37**	(2.68)	21.37*	(2.57)	22.12**	(2.82)
Farm_size	183.2***	(5.21)	183.2***	(5.00)	177.9***	(5.23)
Age	-2.918*	(-2.45)	-2.918*	(-2.35)	-3.089*	(-2.58)
Male	-87.37	(-1.31)	-87.37	(-1.26)	-91.60	(-1.22)
Farmonly	-111.9*	(-2.06)	-111.9+	(-1.98)	-101.8+	(-1.80)
Revshare_othrcrop	-2.567	(-1.38)	-2.567	(-1.33)	-1.271	(-0.79)
Price					285.2***	(3.96)
_cons	142.4	(1.15)	142.4	(1.11)	-1788.2**	(-3.26)
one_lnvar						
_cons	10.61***	(84.97)				
two_mean						
Practice	-37.30	(-1.48)				
Price	285.2***	(4.13)				
Hh_farmlab	-21.30	(-0.59)				
Hh_depend	22.12**	(2.94)				
Farm_size	177.9***	(5.44)				
Age	-3.089**	(-2.69)				
Male	-91.60	(-1.27)				
Farmonly	-101.8+	(-1.87)				
Revshare_othrcrop	-1.271	(-0.82)				
_cons	-1788.2***	(-3.39)				
two_lnvar						
_cons	10.54***	(80.95)				
N	117		117		117	

t statistics in parentheses

Note: The dependent variable is 'CostLab'

Sources: Author's calculation, using Stata 11.

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Channels of the effect of certification on the use of hired labor

	SUR		OLS 1		OLS 2	
main						
Practice	-0.101	(-0.60)	-0.101	(-0.64)	-0.105	(-0.66)
Process	1.661*	(2.11)	1.661*	(1.99)		
Hh_farmlab	-0.430	(-1.60)	-0.430	(-1.41)	-0.416	(-1.35)
Hh_depend	0.115+	(1.78)	0.115	(1.51)	0.113	(1.48)
Farm_size	0.685**	(2.85)	0.685**	(2.74)	0.728**	(2.96)
Age	-0.0248**	(-2.75)	-0.0248*	(-2.51)	-0.0260**	(-2.60)
Male	-0.573	(-0.81)	-0.573	(-0.86)	-0.633	(-0.94)
Farmonly	-0.252	(-0.68)	-0.252	(-0.69)	-0.189	(-0.52)
Revshare_othrcrop	-0.0131	(-0.94)	-0.0131	(-0.87)	-0.00702	(-0.44)
Price					1.468*	(2.52)
_cons	0.391	(0.32)	0.391	(0.32)	-9.127*	(-2.04)
probhire2_HireLab						
Practice	-0.105	(-0.62)				
Price	1.468**	(2.59)				
Hh_farmlab	-0.416	(-1.52)				
Hh_depend	0.113+	(1.75)				
Farm_size	0.728**	(3.12)				
Age	-0.0260**	(-2.91)				
Male	-0.633	(-0.84)				
Farmonly	-0.189	(-0.50)				
Revshare_othrcrop	-0.00702	(-0.53)				
_cons	-9.127*	(-2.10)				
N	117		117		117	

t statistics in parentheses

Note: The dependent variable is 'HireLab'.

Sources: Author's calculation, using Stata 11.

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

quantity of hired labor, then receiving higher price and producing higher quality cocoa lead to an increase in the hired labor input.

As a result, this two dependent variables, *'CostLab'* and *'HireLab'*, support the hypotheses 1-a. and 1-b. while rejecting the hypothesis 1-c. After controlling for relevant determinants, this difference in farm labor input is explained by the higher cocoa quality and/or the organic price premium offered by Esco to certified farmers. On the contrary, this difference in farm labor input is not significantly explained by the use of organic practices.

As a whole, this empirical investigation has supported that organic contract farming increases farm labor demand. By controlling for selection bias, it has been rigorously shown that labor cost increases with the participation in the Esco scheme. Besides, certified farmers are more engaged in the use of hired labor, while less engaged in exchange labor system, than those of the control group. This may suggest that the rise in hired labor input is appreciably stronger than the fall in exchange labor. If this true, organic contract farming provides significant employment opportunities for agricultural workers since the total cost has increased. Nevertheless, this rise in labor demand is not significantly due to the fact that organic practices are more labor intensive – what data have failed to show – but is mainly explained by the higher quality of the production and the organic price premium offered by Esco.

8. Conclusion

The empirical investigation in the Esco organic contract farming scheme in western Uganda has shown that external labor demand has increased for households participating in this scheme. Hence, this finding supports the idea that organic contract farming can create employment opportunities. While this may be limiting in region with scarce labor supply, this represents a positive and valuable spillover in a country like Uganda.

As a result, this study has provided the first step in evaluating the impact of organic contract farming on labor demand. Yet, further research should go on this way in order to quantify this effect and provide a better understanding of its channels. Indeed, while it is commonly assumed that organic practices increase labor requirement, my empirical findings do not support such idea. In this study case, organic farming practices do not have a significant impact on labor demand. The determinants of this increase are mainly the higher price due to organic certification and/or from the up-grading of the cocoa quality. Yet, one study case is not enough for drawing any definitive conclusion and this should be investigated further. Besides, general effects of organic contract farming in Sub-Saharan Africa is still highly under-researched and a deeper evaluation is required before promoting similar scheme on this continent.

References

Adams, J., 1991. The Rural Labour Market in Zimbabwe. Development and Change, 22(2), 297-320.

Ainembabazi, H., 2007. Landlessness Within the Vicious Cycle of Poverty in Ugandan Rural Farm Households: Why and How is it Born? Economic Policy Research Centre, research series n° 49.

Bakewell-Stone, P., Lieblein, G. & Francis, C., 2008. Potentials for organic agriculture to sustain livelihoods in Tanzania. International Journal of Agricultural Sustainability 6, 22–36.

Barrett, C.B., Bezuneh, M., Clay, D.C. & Reardon, T., 2001. Heterogeneous Constraints, Incentives And Income diversification Strategies In Rural Africa. Working Papers 14761, Cornell University, Department of Applied Economics and Management.

Baum, C., Schaffer, M. & Stillman, S., 2007. Enhanced routines for instrumental variables/generalized method of moments estimation and testing. Stata Journal, 7(4), pp. 465–506.

Becker, G., 1965. A theory of the allocation of time. The Economic Journal 75: 493-517.

Bellemare, M.F., 2010. As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming. MPRA Paper 27237, University Library of Munich, Germany.

Benjamin, D., 1992. Household composition, labour markets, and labour demand: testing for separation in agricultural household models. Econometrica 60: 287-322.

Bijman, J., 2008. Contract Farming in Developing Countries: An Overview. Working Paper, Wageningen University.

Blanc, M., Cahuzac, E., Elyakime, B. & Tahar, G., 2008. Demand for on-farm permanent hired labour on family holdings. European Review of Agricultural Economics 35: 493–518.

Blundell, R., & C. Meghir, 1987. Bivariate alternatives to the Tobit model. Journal of Econometrics 34: 179-200.

Bolwig, S., Gibbon, P. & Jones, S., 2009. The economics of smallholder organic contract farming in Tropical Africa. World Development 37, 1094–1104.

Bray, D., Sanchez, J. & Murphy, E., 2002. Social dimensions of organic coffee production in Mexico: lessons for eco-labeling initiatives. Society and Natural Resources, 15, 429-446.

Breusch, T. & Pagan, A., 1979. A Simple Test for Heteroskedasticity and Random Coefficient Variation. Econometrica, 47, 1979, 1287-1294.

Bowers, J., Bailey, B., Hebber, P., Sanago, S. & Lumsden, R., 2001. The impact of plant diseases on world chocolate production. Plant Health Progress, online, doi: 10.1094/PHP-2001-0709-01-RV.

Cameron, A.C. & Trivedi, P.K., 2005. Microeconometrics: Methods and Applications, Cambridge University Press, Cambridge, Mass.

Cameron, A.C. & Trivedi, P.K., 2009. Microeconometrics Using Stata, Stata Press, College Station (Texas).

Clapp, R.A., 1994. The Moral Economy of the Contract. In Peter D. Little and Michael J. Watts, Living under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa, Madison. University of Wisconsin Press.

Chhibber, A., 1988. Raising agricultural output : price and nonprice factors. Finance and development, June 44-47.

Central Intelligence Agency (CIA), 2012. The World Factbook 2012. Washington (D. C.): Central Intelligence Agency.

Cramer, C. & Pontara, N., 1998. Rural poverty and poverty alleviation in Mozambique: What's missing from the debate? The Journal of Modern African Studies, 36 (1), 101–138.

Damiani, O., 2002. Small Farmers and Organic Agriculture: Lessons Learned from Latin America and the Caribbean. International Fund for Agricultural Development, Rome.

Davidson, R. & MacKinnon, J.G., 1993. Estimation and Inference in Econometrics. New York: Oxford University Press.

Davidson, R. & MacKinnon, J.G., 2004. Econometric Theory and Methods. New York: Oxford University Press.

Dmitri, C. & Greene, C., 2006. Recent growth patterns in US organic food markets. In Wellson, A. (Ed.), Organic agriculture in the US, 129-90. Hauppage, NY: Nova.

EPOPA/Export Promotion of Organic Products from Africa, 2008. Organic Exports – A Way to a Better Life?. AgroEco, Bennekom/Grolink, Höje

Erasmus, C.J., 1956. Culture, Structure and Process: The Occurrence and Disappearance of Reciprocal Farm Labor. Southwestern Journal of Anthropology 12, no. 4.

Erasmus, C.J., 1961. Man Takes Control. Indianapolis: Bobbs-Merrill Co.
Estudillo J.P. & Otsuka K., 2010. Rural Poverty and Income Dynamics in Southeast Asia. Handbook of Agricultural Economics, 4: 3435-3468
Eyhorn, F., Mahesh, R., Mader, P., 2007. The viability of cotton-based organic farming systems in India. International Journal of Agricultural Sustainability 5, 25–38.
Fall, P. & Magnac, T., 2004. How valuable is on-farm work to farmers? American Journal of Agricultural Economics 86: 267–281.
FAOSTAT, 2012. FAO Hunger Statistics : Interactive hunger map [online]. Food and Agricultural Organization of the United Nations. Availability: http://www.fao.org/hunger/en/
FAO conference: Annan, K., 2011. Delivering Global Food and Nutrition Security – The Challenge of our Time, Speech at the FAO conference June 25 2011, Rome.
Flores-Lagunes, A., 2007. Finite Sample Evidence of IV Estimators under Weak Instruments. Journal of Applied Econometrics 22, 677-94.
Gibbon, P., 2006. An overview of the certified organic export sector in Uganda. DIIS Working Paper 06/13. Copenhagen: Danish Institute for International Studies.
Gibbon P., Bolwig S., Odeke M. & Taylor A., 2008. Certified Organic Export Production. Implications for economic welfare and gender equality among smallholder farmers in tropical Africa. UNCTAD/DITC/TED/2007/7.
Gibbon, P. & Jones, S., 2011. Developing Agricultural Markets in Sub-Saharan Africa: Organic Cocoa in Rural Uganda. Journal of Development Studies, Volume 47, Issue 10.
Gibbon, P., Lin Y. & Jones S., 2009. Revenue effects of participation in smallholder organic cocoa production in tropical Africa: a case study. DIIS Working Paper 2009, No. 6. Copenhagen: Danish Institute for Development Studies.
Gibbon, P. & Ponte, S., 2005. Trading down: Africa, value-chains and the global economy. Philadelphia: Temple UP.
Gilligan, D.O., 2004. The Determinants of Agricultural Labor Exchange: Theory and Evidence from Indonesia. International Food Policy Research Institute, Discussion Paper.
Giovannucci, D., 1999. The Guide to Developing Agricultural Markets and Agro-enterprises.
Giovannucci, D., 2005. Organic Agriculture and Poverty Reduction in Asia: China and India Focus. International Fund for Agricultural Development: Rome.
Glover, D. & Ghee, L.T., 1992. Contract Farming in Southeast Asia: Three Country Studies. Kuala Lumpur: University of Malaya.
Glover, D. & Kusterer, K., 1990. Small Farmers, Big Business: Contract Farming and Rural Development. New York: St. Martin's Press.
Greene, W. H., 2008. Econometric Analysis. 6th ed. Upper Saddle River, NJ: Prentice–Hall.
Greene, W., 2000. Econometric Analysis, 4th edition, Prentice Hall, Upper Saddle River.
Gronau, R., 1973. The intra family allocation of time: the value of the housewife's time. American Economic Review 63: 634-651.
Grosh, B., 1994. Contract Farming in Africa: An Application of the New Institutional Economics. Journal of African Economies 3(2): 231-261.
Guijt, J. & Woodhill, J., 2008. Missing Links: Growing Organic Chains from Farmer to Market. An Evaluation of Hivos Organic Agriculture Program in East Africa 2000-2006. Prepared for Hivos.
Hausman, J.A., 1978. Specification tests in econometrics. Econometrica 46: 1251–1271.
Havnevik, K., Bryceson, D., Birgegård L., Matondi, P. & Beyene, A., 2007. African agriculture and the World Bank: Development or impoverishment. Uppsala: Nordic Africa Institute.
Hii, C., Law, C., Cloke, M. & Suzannah, S., 2009. Thin layer drying kinetics of cocoa and dried product quality. Biosystems Engineering, 102(2), pp. 153–161.
ICCO, 2007. Supply chain management for total quality in Africa. EX/133/7, 29 May, International Cocoa Organisation. Accessed at http.//www.icco.org/Attachment.aspx?id¼2k146307
IFAD, 2012. Enabling poor rural people to overcome poverty in Uganda. International Fund for Agricultural Development: Rome
Jacoby, H., 1993. Shadow wages and peasant family labour supply: an econometric application to the Peruvian Sierra. Review of Economic Studies 60: 903-922.
Kapoor, K., 1993. Uganda: Growing Out of Poverty. Washington, D.C.: The World Bank

Kelly, V., Jayne, T. & Crawford, E., 2005. Farmers' demand for fertiliser in Sub-Saharan Africa. Department of Agricultural Economics, Michigan State University.

Key, N. & Runsten, D., 1999. Contract farming, smallholders and development in Latin America. World Development, 27 (2), 381-401.

Kirsten, J. & Sartorius, K., 2002. Linking Agribusiness and Small-Scale Farmers in Developing Countries: Is There a New Role for Contract Farming? Development Southern Africa, 19 (4): 503–29.

Little, P. & Watts, M., 1994. Living Under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa (Madison: University of Wisconsin Press).

Lopez, R.E., 1984. Estimating labour supply and production decisions of self-employed farm producers. European Economic Review 24: 61-82.

Lyngbaek, A., Muschler, R. & Sinclair, F., 2001. Productivity and profitability of multistrata organic versus conventional coffee farms in Costa Rica. Agroforestry Systems, 53, 205- 213.

Minot, N., 2009. Contract Farming in Developing Countries: Patterns, Impact, and Policy Implications. In Case Studies in Food Policy for Developing Countries, Volume II: Domestic Policies for Markets, Production, and Environment. eds P. Pinstrup-Andersen and Fuzhi Cheng, Ithaca, NY: Cornell University Press.

Mueller, B. E. T., 2011. The agrarian question in Tanzania: using new evidence to reconcile an old debate. Review of African Political Economy, Vol. 38 (127), pp. 23 - 42.

Mullahy, J., 1997. Instrumental-Variable Estimation of Count Data Models: Applications to Models of Cigarette Smoking Behavior. The Review of Economics and Statistics, 79(4):586-593.

Nabbumba-Nayenga, R., 2003, Landlessness Amidst Abundance. Paper presented at the International Conference : 'Staying Poor: Chronic Poverty and Development Policy', IDPM, University of Manchester.

Newey, W.K., & West., K.D., 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica 55: 703–708.

Nichols, A., 2007. ivpois: Stata module for IV/GMM Poisson regression.
http://ideas.repec.org/c/boc/bocode/s456890.html

Nieberg, H. & Offerman, F., 2003. The profitability of organic farming in Europe. In Jones, D. (Ed.), Organic agriculture: Sustainability, markets and policies, 140-50. Paris: OECD.

Oelofse, M., Høgh-Jensen, H., Abreu, L.S., Almeida, G.F., Hui, Q.Y., Sultan, T., & de Neergaard, A., 2010. Certified organic agriculture in China and Brazil: Market accessibility and outcomes following adoption. Ecological Economics, 69(9), 1785-1793.

Okidi, J.A., 2010. Trends in Ugandan Household Assets During the 1990s. Economic Policy Research Centre. Research series n°38.

Oya, C., 2012. Contract Farming in Sub-Saharan Africa: A Survey of Approaches, Debates and Issues. Journal of Agrarian Change, Volume 12, Issue 1, pages 1–33.

Parrot, N., Olesen, J.E., Høgh-Jensen, H., 2006. Certified and non-certified organic farming. In: Halberg, N., Alrøe, H.F., Knudsen,M.T., Kristensen, E.S. (Eds.), Global Development of Organic Agriculture: Challenges and Prospects. CAB International, pp. 153–179.

Porter, G. & Phillips-Howard K., 1997. Comparing Contracts: An Evaluation of Contract Farming Schemes in Africa. World Development 25(2): 227-238.

Poulton, C., Gibbon, P., Hanyani-Mlambo, B., Kydd, J., Maro, W., Larsen, M., Osorio, A., Tschirley, D. & Zulu, B., 2004. Competition and coordination in liberalized African cotton market systems. World Development, 32 (3), 519-36

Ramsey, J.B., 1969. Tests for Specification Errors in Classical Linear Least Squares Regression Analysis. Journal of the Royal Statistical Society, Series B., 31(2), 350–371.

Reardon, T., 1997. Using evidence of household income diversification to inform study of the rural nonfarm labour market in Africa. World Development 25: 735-747.

Röttger, A., 2004. Strengthening Farm Agribusiness Linkages in Africa: Summary Results of Five Country Studies in Ghana, Nigeria, Kenya, Uganda and South Africa. AGSF Occasional Paper 6. Rome: FAO.

Roy, E., 1963. Contract Farming, U.S.A. Danvill, Illinois: Interstate Printers and Publishers, Inc.

Roy, E., 1972. Contract Farming and Economic Integration. Danville, IL: Interstate Press.

Rundgren, G. & Lustig, P., 2007. Local Organic Markets in Africa. IFOAM 2007 Bonn.

Sadoulet, E., de Janvry, A., & Benjamin, C., 1998. Household behavior with imperfect labor markets. Industrial Relations, 37(1):85–108.

Schiff, M. & Montenegro, C.E., 1997. Aggregate agricultural supply response in developing countries: a survey of selected issues. Economic Development and Cultural Change, 45(2): 393-410.

Scialabba, N. & Hattam, C., 2002. Organic Agriculture, Environment and Food Security. Environment and Natural Resources Series No. 4. Rome: Food and Agriculture Organization of the United Nations.

Skoufias, E., 1994. Using shadow wages to estimate labour supply of agricultural households. American Journal of agricultural Economics 75: 20-32.

Simmons, P., 2002. Overview of smallholder contract farming in developing countries. Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations. FAO-ESA Working Papers, 02/04.

Smith, R.J. & Blundell, R.W., 1986. An exogeneity test for a Simultaneous equation Tobit model with an application to labor supply. Econometrica,54:4, 679-686.

Thamaga-Chitja, J. & Hendriks, S.L., 2008. Emerging issues in smallholder organic production and marketing in South-Africa. Development Southern Africa 25(3), 317-326

Tovar, L.G., Martin, L., Cruz, M.A.G. & Mutersbaugh, T., 2005. Certified organic agriculture in Mexico: market connections and certification practices in large and small producers. Journal of Rural Studies 21, 461–474.

Uganda Bureau of Statistics (Ubos), 2007. National market labor indicators.

Uganda Bureau of Statistics (Ubos), 2005. 2005 PHC Agriculture Module.

Uganda Bureau of Statistics, 2011. Uganda Census of Agriculture (UCA) 2008 / 2009: At a glance.

Uganda Bureau of Statistics, 2010. Volume 4 – Uganda Census of Agriculture (UCA) 2008/2009 : Crop area and Production report.

Uganda Bureau of Statistics, 2010. Uganda Census of Agriculture (UCA) 2008 / 2009 - Volume 3 : Agricultural household and holding characteristics report.

Uganda Bureau of Statistics, 2000. Uganda National Household Survey 1999/2000.

Uganda Bureau of Statistics, 2002. Uganda Population and Housing Census 2002.

Uganda Bureau of Statistics, 2009. Consumer price index: September 2009.

United Nations, 2000. United Nations Millennium Declaration: resolution adopted by the General Assembly. United Nations, New York.

United Nations, 2011. The Millennium Development Goals Report 2011. New York: United Nations

Valkila, J., 2009. Fair Trade organic coffee production in Nicaragua—sustainable development or a poverty trap? Ecological Economics 68, 3018–3025.

Warning, M. & Key, N., 2002. The social performance and distributional consequences of contract farming: An equilibrium analysis of the Arachide de Bouche programme in Senegal. World Development, 30 (2), 255-63.

Watts, M. J., 1994, Life under Contract: Contract Farming, Agrarian Restructuring, and Flexible Accumulation. In Peter D. Little and Michael J. Watts, Living under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa, Madison, WI: University of Wisconsin Press.

Willer, H. & Kilcher, L., 2012. The World of Organic Agriculture - Statistics and Emerging Trends 2012. Research Institute of Organic Agriculture (FiBL), Frick, and International Federation of Organic Agriculture Movements (IFOAM), Bonn.

White, H., 1980. A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. Econometrica, 48, 817-838.

Wooldridge, J.M., 2002. Econometric Analysis of Cross Section and Panel Data. MIT Press.

Wooldridge, J. M., 2009. Introductory Econometrics: A Modern Approach. 4th ed. Cincinnati, OH: South-Western.

World Bank, 2005. World Development Indicators.Washington DC: World Bank

World Bank, 2008. World Development Report: Agriculture for Development. Washington, DC: World Bank.

Wu, D.M., 1974. Alternative tests of independence between stochastic regressors and disturbances: Finite sample results. Econometrica 42: 529–546

Zellner, A., 1962. An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. Journal of the American Statistical Association 57: 348–368.